FUNDAMENTALS
OF
NAVAL SERVICE

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FUNDAMENTALS
OF
NAVAL SERVICE

BY

COMMANDER YATES STIRLING, U. S. N.

SPECIAL CHAPTERS

THE NAVAL AEROPLANE......BY LIEUT. COMM. H. C. MUSTIN, U.S.N.
ELECTRICITY IN THE NAVY..BY LIEUT. COMM. C. S. MCDOWELL, U.S.N.
FIRST AID AND HYGIENE.....BY RALPH WALKER MCDOWELL, M.D.
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PREFACE

"FUNDAMENTALS of Naval Service" has been prepared to serve as a Manual to those of our citizens who are interested in the United States Navy and who may choose to serve their country on the water.

It is evident that much of importance must be omitted from a book of such limited pages, but the bibliography should furnish a means to those whose appetite for knowledge goes further than the capabilities of this volume.

The great increases in the personnel of the navy must be supplied in part from our inland states, where the navy and its work is little known; to the citizens of those states this book gives in a single volume information on naval matters possible to obtain only by the reading of many different volumes. All those who go upon the water, either for pleasure or duty, it is hoped, will find it useful, epitomizing as it does a variety of information upon a large number of subjects.

Thanks are due to Commanders F. R. Payne and F. A. Traut, U. S. Navy, for assistance in the preparation of the chapter on Naval Reserve and to Lieutenant John Stapler, U. S. Navy, in the preparation of the development of the torpedo. Also to those writers on naval subjects who will find their own thoughts and expressions in the warp and woof of the weaving the author makes grateful acknowledgment.

The manuscript of this book has been read by, and published with the approval of, the U. S. Navy Department.

YATES STIRLING, JR.

March 30, 1917.

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FUNDAMENTALS OF NAVAL SERVICE

CHAPTER I

POLICY AND WAR

Policy.—A state in its life struggle bears a striking resemblance to an individual. It is a collective entity. It endeavors continuously to promote its own welfare, sometimes even at the expense of another state.

A democracy is guided in its development by a few individuals selected by the many. The safety of the state is in the keeping of these men. For the time being they become the rulers of the state. In the work of the state the tools of the state are under their control. The only limitations are the laws of the land, including the Constitution, legislation already enacted and treaties with other sovereign states. This comparatively small body of men formulate plans and carry on their work accordingly. The citizens of the state, through the medium of popular opinion, the press and the ballot, approve or disapprove of the plan both as to the conception and execution.

A state, like an individual, will recognize and obey the first law of nature and insist that effective means be taken to insure self-preservation. A full recognition of the impelling necessity to heed this law comes to a state through competition with foreign states. It discovers in due course that it has both friends and enemies among the sovereign states of the world. It learns the rude lesson that success or failure depends upon abilities and opportunities.

From out the many conflicting intelligences of a state there arise certain conceptions of national development or policies. Modified through external contact with other states and in their final form expressing the deepest conviction of the people, they become doctrines for which the state will go to extreme lengths to preserve. It becomes the duty of the statesmen in temporary control of the acts of the state to take stock of the measures to be used in support of these doctrines and to make certain always that the realization of these conceptions will correspond to expectations.

In all civilized states there exists a constant effort making for the development of the intelligence of the individuals of the state. A coördinate faith in the policies of the state strengthens the hands of the statesmen.

It is evident that many conceptions are formulated by statesmen; only a few crystallize into policies, and a lesser number into doctrines. There arises the need for intelligent control of effort in the realization of these policies or doctrines. We have now arrived at the borderland where one sovereign state holds intercourse with another in the furtherance of its aims. A state must obtain the consent, willing or otherwise, of other states affected by the action of its policies in order that peace may be maintained. The means employed is termed diplomacy. The same character of intellectual attainments is required as was needed in framing the policies.

The failure of diplomacy transfers us into another field wherein the training of the statesmen is insufficient for the task.

War.—It is therefore evident that war has its root in a political object. A war between civilized nations always starts from a political condition. It owes its existence to a political motive. War, therefore, is a political act. The political motive which caused the war must during its continuance receive the first and highest consideration. In the conduct of the war the political motive must ever be held in view. Governmental policy must remain inter-

woven with the entire action of the war; it must be allowed a continuous influence upon it. This higher power must subordinate the forces liberated by war. Naval and military acts must be coördinated with the political motive to which the war owes its existence, in order that the political object may be successfully attained.

It must be recognized at the outset that war is a political instrument, a continuance of political intercourse. Once the armed forces of a state are called upon to act, the art of war begins to encroach upon the political view. A dynamic force has been released that requires the highest specialized talent to successfully control; yet, the political view is the object, *war* is but the *means,* and it must ever reckon with the object. The political motive must remain the guiding intelligence.

CHAPTER II

OUR NAVAL POLICY—PAST AND PRESENT

A POLICY or doctrine, challenged by another sovereign state, cannot continue to exist unless there is sufficient force behind it to maintain it.

It therefore becomes the most important duty of our statesmen to foresee the rise of a state that may be expected to challenge our policies or doctrines, and prepare the armed forces of the state to successfully resist this challenge, even to the ultimate—war. National policy must be coördinated with the nation's force. The nation's force is its Army and Navy. In peace these two, considered as a single instrument, exist as a potential argument of diplomacy. In war they become a militant power for the realization of the aims of the state.

It is plain that our national policies must ever be the starting point in our calculations for military and naval strength. The military and naval forces of a state are the concrete manifestation that the state is determined to continue its development along the lines expressed in its policies.

Unhappily, our national policies have been formulated independently of the dynamic force required to give them effect. The state has indulged its ambitions in policies, but has continuously refused to create sufficient force to maintain them in the event of challenge by those military states to whom such policies appear repugnant.

This unhealthful national custom has not grown up from the lack of patriotic intelligences that have in each generation raised their voices to awaken their fellow countrymen from their sleep of artificial security, and lead them to a correct understanding of the fundamental principles governing in the free life of a state.

It was but natural that in the War of 1812 with Great

Britain, the United States would find itself with comparatively few warships to combat the vast navy of the enemy, but there was no excuse for the woeful weakness shown after so many warnings. Thirty-six years had elapsed since the Declaration of Independence, during which time England had been almost continuously engaged in a war that had spread to nearly all of Europe, while the United States, the neutral, had successfully built up a merchant fleet that was arousing the jealousy of the great maritime powers across the seas, especially England.

Jefferson, as Secretary of State, in 1793, although cherishing a passion for peace and an abhorrence of navies, recommended to Congress "a respectable body of citizen-seamen, and of artists and establishments in readiness for shipbuilding." This implicit relegation of defense to the untrained and unskilled efforts of a purely civil force has been this country's besetting sin. From such a source this should have been a potent warning to Congress that some measure of naval defense was required. Jefferson again wrote, urging against depending upon the justice of other states to give fair and equal access to markets. For our share in the transportation of them, he said, "Trust to our own means of independence and the firm will to use them."

In October and November, 1793, no less than eleven ships and more than a hundred American seamen were captured by the pirates of the Barbary Coast. These pirates were encouraged by England and France to prey upon the commerce of weak maritime nations. These insults awakened Congress to some slight measure of action. Six frigates, four of 44 and two of 36 guns, were authorized. The act met with most violent and bitter opposition in Congress. Economy was the chief motive, but the traditional prejudice of our citizens to standing forces, especially naval, must be given due weight. In order to pass this meagre appropriation to safeguard the very existence of the young struggling republic, it was found necessary to make concession to these sentiments. In

the bill it was stipulated that upon the conclusion of the treaty with these pirates—Algiers—the work upon the frigates be stopped. The treaty with Algiers was not a treaty; it was a bribe; a large ransom paid by Congress to protect the growing American commerce plying the waters of the Mediterranean. The six frigates were begun under the guidance of a Pennsylvania ship builder, Joshua Humphreys, and six captains were selected to superintend their construction. Portsmouth, N. H., Boston, Mass., New York, N. Y., Philadelphia, Pa., Norfolk, Va., and Baltimore, Md., were each allotted the building of a ship. The captains selected have since nearly all become famous in our naval history—Barry, Nicholson, Dale, Truxtun, were among the number.

Humphreys was a man of great ability and foresight. His opinion upon our naval requirements showed marked common sense and an understanding of the tactical principles governing sea actions of that day. "Such frigates as in blowing weather would be an overmatch for double-decked ships or in light winds may evade coming to action by outsailing them," was his idea for the six vessels just authorized by Congress. "If we build our ships," he wrote, "of the same size as the Europeans, they having so great a number, we shall always be behind them. I would build them of a larger size than theirs and take the lead of them, which is the only safe method of commencing a navy."

Gouverneur Morris and John Adams consistently begged that more ships of war be built and manned, but Congress, beholding the great fleets of England, lost hope and heart. Because America could not build and man a fleet as numerous as that of Great Britain many advocated no ships, declaring it was vain to have a navy at all. We hear the same calibre of logic even to-day.

Both Adams and Morris endeavored to impress upon their countrymen that in the complicated tangle of warring interests even a few American ships of the line might mean the difference between peace and war; for as yet

only frigates had been built. "I believe," Morris wrote the Secretary of State, "that we could now maintain twelve ships of the line, perhaps twenty, with a due proportion of frigates and smaller vessels, and I am tolerably certain that, while the United States of America pursues a just and liberal conduct, with twenty sail-of-the-line at sea, no nation on earth will dare to insult them. I believe also that, not to mention individual losses, five years of war would involve more national expense than the support of a navy for twenty years. One thing I am thoroughly convinced of, that, if we do not render ourselves respectable, we shall continue to be insulted."

The parsimonious attitude of Congress allowed for only frigates and Humphreys built them the match of any similar vessel in the navies of Europe.

In 1795 the United States bought and paid for a treaty with the Dey of Algiers costing only $100,000 less than the price of the six frigates. Having bought safety from the pirates the work on the frigates was stopped. Similar treaties were arranged with the remainder of the Barbary States at lower rates. Buying safety by payment of money is sufficiently degrading, but less degrading than its purchase with the suppression of policies that are the very foundation upon which our liberty as a nation is based.

A majority in Congress succeeded in passing an act to continue the building of three of the six frigates. The now famous ships, the "United States," the "Constitution," and the "Constellation," were pushed to completion and composed the first squadron of the United States Navy.

Our rapidly growing commerce continued to sail every sea. During the wars incident to and following the French Revolution, from 1793 to 1815, the United States was in the position of the feeble and timid neutral between aggressive and fully armed belligerents. Our commerce suffered vexations and spoliations from each of the belligerents in turn. Our distant trading vessels were exposed constantly to armed attack. The protection

of a navy was denied by Congress. Our merchantmen in European waters were threatened by pirates in times of peace, by privateers in times of war.

The menace of French aggression finally caused Congress, in 1798, to adopt a definite policy of defense. One measure was the completion of the remaining three frigates. These were the "Congress," the "Chesapeake," and the "President." In the next year Congress authorized the building of twelve vessels of 22 guns each. In the same year, on the 30th of April, the conduct of naval affairs was vested in a newly-created Department of the Navy, of which Benjamin Stoddert was appointed Secretary.

After the settlement of the difficulties with France, it was decided to reduce the Navy, and Congress, in 1801, authorized the President to sell all but the thirteen largest frigates, namely, the "President," "United States," "Constitution," "Congress," "Constellation," "Chesapeake," "Philadelphia," "New York," "Essex," "Adams," "John Adams," "Boston," and "General Greene." Six of the above were to be retained in full commission, while the remainder were allowed to rot in "ordinary." The personnel of the navy was proportionately reduced.

Hardly had this unwise measure of retrenchment been accomplished before new difficulties arose with the Barbary States. Having paid large tribute to one of the pirates, all now claimed their *right* to share in the blood money wrung from a peace-loving nation of money makers.

Morris's words had come true: "If we do not render ourselves respectable we shall continue to be insulted," and we were insulted by such powers as Tunis and Tripoli. The Pasha of Tripoli inquired why he was being slighted. "I can hurt the commerce of the United States as well as the Algerians and Tunisians," he was reported to have declared. In a written demand for tribute addressed to the President, the following insolent *passage occurs:* "We could wish that these your ex-

pressions were followed by deeds, and not by empty words. You will therefore endeavor to satisfy us by a good manner of proceeding. We on our part will correspond with you with equal friendship, as well in words as in deeds. But if only flattering words are meant, without performance, every one will act as he finds convenient. We beg a speedy answer without neglect of time, as a delay on your part cannot be but prejudicial to your interests."

At last American manhood awoke and refused the payment of further tribute. A squadron of warships was sent to punish the insolent pirates.

Two years later Congress increased the naval force by four vessels, small and inadequate, yet sorely needed for the protection of our commerce against pirates and privateers. No further additions were made. Morris's advice remained unheeded. No ships of the line were laid down, and yet with so hopelessly inadequate a navy our national policies were pushed forward all the more vigorously. The time was fast approaching when the challenge would come. Policies and so-called national rights challenged must show that there exists adequate force behind them to maintain them. A nation under such circumstances may suppress the policy, give up the right or else fight to maintain its prestige as a free and equal national agent among other nations. Inadequate force for defense can mean only national disaster.

The greatest and most bitter insult came in 1807. The frigate "Chesapeake" was stopped off the Capes of the Chesapeake by a British warship, the "Leopard," carrying 50 guns. Upon the American warship's refusal to permit visit and search for British naval deserters, the "Leopard" opened fire upon the American warship; twenty-one American sailors were killed or wounded. The "Chesapeake" was reduced to submission and was searched; four of the American warship's crew were removed; one was hanged, one died and the other two were held for some time in captivity. This insult happened at *our very* doors, off the Capes of the Chesa-

peake. If Morris had been heeded such would not have happened, but if it had, retaliatory measures would have been possible.

In a note written by James Monroe, American Emissary to Great Britain, to the British Secretary of State, George Canning, upon the " Chesapeake-Leopard " incident, he characterizes the insults which had to be patiently borne by a country unprepared to defend its rights in strong language indeed. " I might state other examples of great indignity and outrage," he wrote, " many of which are of recent date, to which the United States have been exposed off their own coast, and even within several of their harbors, from the British squadron; but it is improper to mingle them with present more serious causes of complaint."

Canning in his retort accused Monroe of precipitating action ahead of knowledge and deliberately mingling the lesser grievances with the greater, while at the same time admitting the impropriety. Admiral Mahan gives us the reason for Monroe's methods: " That a government which by its own fault is weak will try with big words to atone to the public opinion of its people for that which it cannot, or will not, effect in deeds. Bluster, whether measured or intemperate in terms, is bluster still, so long as it means only talk, not act."

With war ever in sight over the impressment of American seamen by British warships on the high seas, the United States took no adequate steps to place itself in a position to defend itself. Our statesmen and legislators merely flung note after note across the sea and made legislation which accomplished nothing but to twist further the Lion's tail and make Great Britain more anxious to curtail the liberty of the sea to our merchant marine.

The embargo act, passed by Congress as a retaliatory measure short of war, prevented American ships from clearing from our own ports and left our exports to rot in the warehouses and bade the seamen and ship owners of the day to starve. The statesmen of the United States.

while taking such drastic measures, in order to hurt a powerful foreign state, yet refused to build national ships of war for the protection of our trade and our coast.

"I have believed and still do believe," wrote John Adams, "that our internal resources are competent to establish and maintain a naval force, if not fully adequate to the protection and defense of our commerce, at least sufficient to induce a retreat from these hostilities and to deter from the renewal of them by either of the harrying parties." "In short," explains Mahan, "to compel peace, the first object of military preparation."

Adams attempted to prevail upon Congress to heed his warning and build a navy. He urged it would be cheaper than a three years' embargo; but Jefferson's counsel prevailed. Gunboats became the idea for protection instead of ships of the line. To abandon the sea was Jefferson's method to avoid trouble. If it were possible, he would have placed both the navy and the merchant marine on wheels and run them inland.

"This exuberant commerce," he wrote, "brings us into collision with other Powers in every sea and will force us into every war with European Powers."

The sea was odious to Jefferson and the body of men who stripped the seaman and his employer of a livelihood and refused to give them the armed protection which the resources of the state were ample to provide.

The examples of Holland and England, whose greatness came from the ample use of the sea, Jefferson could not profit by. He was an ancient Chinese in his mental outlook upon the world. He was timid and, above all, feared to involve his beloved country in war. During his administration not a single ship of war was added to the navy. He left office in 1809, probably never appreciating that by his anxiety to avoid war with England his acts made the war not only certain but actually hastened it.

Having studiously refused to build a navy for the defense of our policies, our statesmen appeared to be at a loss to understand why the country was everywhere

insulted. While the Secretary of the Treasury prided himself publicly upon the economies of an administration that had seriously crippled the war power of the nation, leaving it helplessly drifting upon the rocks of war, the bellicose Secretary of the Navy wrote such orders as these to the inadequate squadron of Commodore Rodgers: "What has been perpetrated may again be attempted. It is therefore our duty to be prepared and determined at every hazard to vindicate the injured honor of our navy, and revive the drooping spirit of the nation. It is expected that while you conduct the force under your command consistently with the principles of a strict and upright neutrality, you are to maintain and support at every risk and cost the dignity of our flag; and that offering yourself no unjust aggression you are to submit to none, not even a menace or threat, from a force not materially your superior." Having failed utterly to supply the force to protect the honor of the flag, the statesmen sent forth an inadequate force of brave, determined fellow-citizens in old, undermanned ships, with orders to do and dare as if they had been provided with an adequate force for the purpose.

Rodgers and his officers only too gladly welcomed such orders. They burned to avenge the "Chesapeake" and other indignities done their countrymen by the British navy. What might have occurred if the statesmen in the decade before the war had done their duty by the country, in providing an adequate fleet, can be surmised. Even with his small force of frigates, Rodgers was held in some awe by the British ships of war. With an adequate force, war probably would not have occurred. England could ill-afford to risk a collision with a prepared and determined maritime power. She would have preferred to adjust the difference diplomatically.

During the years of peace Congress gave scant heed to the navy. Statesmen did not consider in their diplomacy that an adequate naval force was an asset much needed to secure lasting success. The war with Mexico

found us with few ships of war, barely sufficient for the convoy of our army to Vera Cruz and totally inadequate in numbers for a blockade of the Mexican Coast.

On the 4th of March, 1861, a month before hostilities opened in our great Civil War, there were just twelve national vessels in service on the Atlantic Coast of the United States. The stern necessities of war increased this number by December 1 to two hundred and sixty-four warships, carrying a total of 2557 guns and 22,000 sailors. Half of these were built and half purchased. All were manned by untrained men and their cost was enormous. Over one-half were steamers, including three ironclads and twenty-three first-class gunboats.

In 1865 the United States Navy was second to none. Its ships were battle-scarred veterans and the personnel had been trained throughout four long years of actual conflict. A new type of ironclad had been built and proved. The monitor led in formidableness and effectiveness all other types of warships. Yet once the war had ended, Congress gave no further heed to the navy which had been the most potent instrument for success to the Union cause. The navy was permitted to fall into dry rot. Ships were sold or "scrapped" and the sailors were discharged.

The United States, until within the last two decades, had never felt the pressure of conflicting national policies. The Monroe Doctrine, denoting a principle that would have been wrought out, even if the message of 1823 had never been written—"the principle of the limitation of European power and influence in the Western Hemisphere"—had never been questioned.

In the study of history, the most striking truth is that commerce is the basis of most international disputes. The Monroe Doctrine, a national policy believed by the United States to be a corollary to our national safety, was actually instigated by England, our most bitter competitor in the commerce of the Western Hemisphere. The safety of the new Republic was not considered by England; what concerned her most was the fear of losing

her trade with the old Spanish colonies if Spain were permitted to reconquer them.

The Louisiana Purchase was made in order to obtain the free navigation of the Mississippi River. New Orleans as a place of deposit and with many miles of river debouching into the very middle of the United States, if under the control of a foreign and, likely enough, a hostile nation, was an alarming possibility.

So long as the Monroe Doctrine was subscribed to by England, the United States gave no heed whatever to sea power as a diplomatic argument. England's fleet was ample to protect our commerce as well as her own. Our interests might conflict, but we depended upon the sentiment of the blood tie and a common language to save us from open hostilities. There were no other nations to be considered commercially. Germany had not appeared as a rival of England on the seas nor a possible dissenter in the principle embodied in the Monroe Doctrine. Mr. Cleveland's Venezuela message was fraught with grave possibilities. That the United States, then as always pitifully unprepared to back by force of arms the dictum of its President, did not find itself at war with England was due somewhat to the complacency of British statesmen towards Brother Jonathan, but largely because England was busily occupied by the jealousies and conflicts of interests in Europe. It is possible that the President understood this and believed the time was ripe to successfully twist the British Lion's tail.

Finally the war with Spain embarked us upon the sea of Empire. It was not until then that our statesmen seemed suddenly to appreciate the value of naval force as a potential argument of diplomacy. Now that appreciation happily seems to be universal. The difficulty lies in determining the minimum strength of the naval force required in order that the argument may be won without the use of that force dynamically.

This leads us inevitably to an examination of Naval Strength and the principles underlying war on the sea.

CHAPTER III

THE IMPORTANCE OF NAVAL STRENGTH

Let us be warned in the outset not to confuse Naval Resources with Naval Strength. Resources are merely the raw materials and cannot be classed under strength until these materials have been fashioned into effective implements for war. Mere ships with depleted or untrained crews are resources; warships fully manned and trained for battle are strength. A fleet, undermanned, incompletely provided with ammunition and guns, lacking auxiliaries required for its service, short of destroyers, scouts, battle cruisers and submarines, although backed by the entire resources of the country, is a source of naval weakness rather than strength. A fleet just too weak is worse than no fleet at all.

National resources are indispensable, but they must be harnessed, organized, to be effective. To build a battleship inside of two years would be a proud exhibition of the country's resources, showing that these resources had been organized and administered effectively in the service of the state. When four and five years are required to put into commission a first-class ship from the day Congress has appropriated the money, it must be conceded that the resources of both the government and the country have been permitted to fall behind expectations.

The problem of naval preparation for war is both perplexing and stupendous. At the root there must be the clearest understanding that war is a political act. It does not come suddenly and without warning. Statesmen and the reflective men and women of the country will have diagnosed the symptoms of the terrible disease long before it grips the nation by the throat and exacts a toll of the best blood of the land. During these years

when the symptoms only are in evidence preparation should be continuously made and diplomacy fashioned to maintain peace by timely agreement, "while men's heads are cool and the crisis of the fever has not been reached." The statesman's duty meanwhile is none the less that of assuring himself of the actual naval strength he can count upon at the moment in the event that his diplomacy should fail to ward off the impending conflict.

The responsibility for ample preparations for war lies with the government of a state, the legislature and the executive. These should know the extent of national force required by national interests. Mahan has truly said: "Preparation should be adequate to the utmost demand that under the international conditions can be made upon it, and, if possible, so imposing that it will prevent war ensuing, upon the firm presentation of demands which the nation believes to be just."

War with Mexico was delayed, if not averted, by the recent mobilization on our border of all our regular forces and the militia of many states of the Union. At the same time the President made demands which the nation believes to be just. Here we see Mahan's maxim strikingly exemplified.

In order to arrive at the required naval strength, there is the primary necessity of considering the political horizon on all sides. The war clouds, their texture and extent, can be judged only by those intimately acquainted with the political conditions in the world about us—the statesmen. They must fashion their naval strength against the most formidable opponent. This opponent may not be the most probable or more imminent, but if we prepare for the greatest danger we shall have placed ourselves in a position to safeguard our country against the lesser but more immediate collisions. All this is the duty of our statesmen.

In the actual calculation of naval strength required we must consider the actual force which a possible opponent may liberate from its own political restrictions and

send against us. We must further consider what degree of passive or active aid other nations may afford this opponent or ourselves.

From here onward scientific intelligences must be called into play. We must deal now in those highly specialized implements of naval warfare which statesmen have vainly endeavored to understand and master but ever to their country's undoing.

It may be said that there are two primary elements of naval strength. One is purely defensive, while the second is as equally offensive.

The defensive element comprises safely fortified bases, well and sufficiently equipped for the service of the fleet and correctly located strategically; an efficient home base of supplies, which means the mobilization of the national industries and resources to permit the carrying forward of the naval plan of campaign; sufficient merchant tonnage to serve the needs of war and continue uninterrupted, in so far as practicable, our commercial activities on the seas; the protection of our lines of communication to strategical bases, the safeguarding of our outlying dependencies and the successful patrol of our important trade routes; and the efficient control of all these activities by a system of quick and ready communication—cable, telephone, wireless, and agents in important neutral and even enemy's ports.

The offensive element is the Fleet. To use a newly-coined phrase, it must be a "well rounded out" fleet, comprising all the required types for service in naval offensive war: Capital ships (battleships and battle cruisers), scouts, destroyers, mine layers, submarines, aeroplanes, airships and auxiliaries. It must be trained to the minute; properly and adequately manned with trained men; with its magazines stocked with ammunition and storerooms and fuel spaces filled and sufficient for weeks and even months of service upon the high seas in waiting for its opponent.

These are the elements of naval strength which must

be developed and must parallel our aims for national betterment. What strength? What type? What number? The answers must ever be comparative. The formula is algebraic. X and Y must be solved; therefore appropriate equations must be given. These are given by the statesmen. The specialist, the naval officer, not as an individual, but as a collective, reflective, trained intelligence, must solve the problem and announce the minimum strength, type and number required for the purpose of successful war with the most formidable opponent.

The importance of naval strength is best exemplified in the history of England. The area of the British Isles is a little more than one-half that of the state of California, yet from those islands the world has been ruled for over two centuries. England ruled the world by obtaining and keeping command of the sea. Francis Bacon truly said: " He that commands the sea is at great liberty, and may take as much and as little of the war as he will. Whereas those that be strongest by land are many times, nevertheless, in great straits." Great Britain's power and wealth, in fact her very existence, depended upon the free use of the sea. Any nation that threatened the British control of the sea struck a blow at the foundation of the British Empire. In the days of sail, Britain's supremacy was threatened several times by maritime nations. Holland and Spain each threatened her commercial supremacy on the sea and each in turn was vanquished by that unconquerable sea power. The great Napoleon was " strongest by land." As a prisoner on board the " Bellerophon " in 1815, he exclaimed, in his habitually impassioned way, to Captain Maitland, commanding that British warship: " Had it not been for you English, I should have been Emperor of the East, but wherever there is water to float a ship we are sure to find you in our way."

History proves to the hilt that maritime commerce goes hand in hand with naval strength; Athens and Carthage were no longer able to protect their fleets of

merchant ships when sea power was wrested from them by Rome. If in the great war now in progress the sceptre of the sea should be knocked from the hands of Britannia, England's great maritime commerce would pass into the hands of the victors. Great Britain would cease to be an Empire. Her colonies, no longer under the protection of her fleets, would drop from her and become independent states, else bow to the yoke of conquest.

Naval strength gives the power of initiative in commercial activity. Naval weakness precludes such initiative.

Spain, once a proud sea power, held dominion over continents. Her bold navigators sailed every sea. The wealth of the Orient and of the newly-discovered Americas poured a golden stream into the Peninsula—scarcely larger than the state of California. The invasion of England was among the dreams of Spanish sea power, as it was of Napoleon I, several centuries later. The British Navy saved England from such a fate. England has been called perfidious, but her existence required the annihilation of any maritime power daring to rival the British Fleet. With the defeat of the fleet, England must pass away as did Athens, Carthage, Holland and Spain before her.

The evolution of sea power began with maritime commerce. When the importance of this traffic across the water was understood by states, they recognized the need to protect it. At first merchant ships went armed and frequently were built with this end in view. Afterwards great commercial companies were formed by the wealthy merchants of the maritime states. Distant commerce was always exposed to armed attack by pirates, privateers, trade rivals and even by hostile natives to whom the merchandise was being transported. By combining against the great hazards of the sea, the loss was more easily stood by many men rather than by a handful of traders. In due time the state began the protection of its commerce by building *warships* to police the seas and safeguard

the trade routes along which their peaceful merchant ships passed. Mahan has stated that: "Navics depend upon maritime commerce as the cause and justification of their existence." Then he in a later writing declares this is true only to a certain extent and gives the United States as a nation without shipping yet requiring a strong navy to exemplify the exception to the rule. The navy of the United States owes its existence to maritime commerce; that is distinctly clear; apparently, however, it does not owe its continuance and its growth to this factor. The growth of our naval power, Mahan agrees, must be charged to political and international reasons. Be that as it may, the maxim of Mahan *is* nevertheless involved in the development of the naval strength of the United States, for a nation once a maritime power but shorn of that power through naval weakness will yet appreciate the principle that "Maritime commerce is the cause and justification of a navy," and will strive to retrieve a mistake by acquiring the navy before the commerce, in order to have the protection ready for use. When our navy is of such strength that even for the mightiest naval power a war with us would involve such risks as to jeopardize its own supremacy, then our maritime commerce, unfettered, will expand to every sea without fear of molestation.

CHAPTER IV

PRINCIPLES OF NAVAL STRATEGY

A BARE statement of principles, useful doubtless to the man trained to use them, is of small value to one who desires to become proficient but who cannot, from his experience or his study of history, clothe them with illustrations. The author, therefore, suggests to those desiring to make the experiences of others their own—for history is but the experience of others recorded for our use—a careful reading of the brilliant books of Admiral Mahan and those of Julian S. Corbett. These two naval historians were contemporary writers, the broad Atlantic lay between them, yet each took inspiration in the other's works.

Speaking of the value, to the naval student in strategy, of historical research, Mahan discusses the quotation: "On the field of battle the happiest inspiration is often only a recollection." He says: "This is a testimony to the value of historical illustration, which is simply recorded experience; for, whether the recollection be of what some other man did, or whether it be of some incident one's self has seen and recalls, it draws upon the past; and that, too, not in a general way, but by specific application to an instant emergency, comprehended at a glance, just because it is familiar." Principles without illustration are dangerous to the novice. Having the principle, an illustration helps to hold the principle in the mind all the more firmly. Learning the bare principles is a conscious act; grasping principles through illustration passes the knowledge from the conscious to the subconscious. The old saw, "A burnt child dreads the fire," is only another way of saying that a child told the principle that fire burns may consciously believe it, but after illus-

tration upon his small body will know and fear the fire subconsciously, without mental effort.

We see examples in our everyday life of men seeing other men destroyed through violation of a principle or law of nature, without taking profit thereby, simply because they did not know the principle or else did not understand its application.

Admiral Mahan illustrates this failing by the desire of Congress to divide our fleet equally between the Atlantic and Pacific Coasts. Yet each Congressman and Senator probably knew, or should have known, that the Russian navy suffered defeat through the disregard of the very principle Congress was so willing to ignore. Only the other day it was proposed by a Senator, on laying down six or more dreadnoughts and battle cruisers, to provide that three of these should always remain on the Pacific Coast. Here lies a great danger to the Republic—we must understand that strategical principles must lie outside of Congressional legislation.

Strategical principles must be obtained from military study. "Study is simply the intelligent observation of incidents, of events, and drawing from them conclusions." The larger and more varied our illustrations the more certain are we of our inferences. The principles rest upon a firmer foundation.

Naval strategy is as necessary in peace as in war. The acquisition of strategical positions by treaty or purchase in peace may gain for us greater victories than could be obtained in war. It might in fact make victory assured. On the other hand, war might be seen so dangerous to our enemy as to cause him to remain at peace. "Naval Strategy has for its end to find, support and increase, as well in peace as in war, the sea power of a country."

Corbett divides Sea Strategy into Maritime and Naval Strategy. "By Maritime Strategy," he says, "we mean the principles which govern a war in which the sea *is a* substantial factor. Naval Strategy is but that part

of it which determines the movements of the fleet when Maritime Strategy has determined what part the fleet must play in relation to the action of the land forces."

Corbett considers that naval action alone cannot decide a war. Naval pressure acts to exhaust an enemy by shutting off his commerce. Naval Strategy in the broadest sense decides the locations and the naval forces to be employed for action in the war.

In the present war England's maritime strategy was to clear the seas of enemy's ships, to protect her own merchant marine in all parts of the world, to seize all colonial possessions of her enemies, to convoy her land forces by water to the battlefields of Europe, and to concentrate in the North Sea a force sufficiently great to contain the German Fleet; the remainder to be used to reënforce the fleet of her allies. Her naval strategy distributed the British naval forces according to a carefully worked out strategical plan, whose operation is unfolding before the eyes of the world as the war on the sea progresses.

At a time well within the recollection of the writer the fighting ships of the world were dispersed singly or in pairs over the civilized world—police duty, to show the flag, it was called. A study of naval strategy has changed all this. Principles have been deduced and are being applied. The most important principle of "Concentration" has called ships together into fleets and located them at strategic points. Our own fleet, composed of our heaviest battleships and the bulk of our destroyers, scouts and submarines, is located in the Atlantic Ocean.

Nations, as human beings, obey the impulse of nature's laws. Each military nation of the world, instinctively, has concentrated its fleet where it can guard the most vital organ of the nation, the heart. With this idea in mind the fleet is assumed by the nation to be a weapon of defense and its primary duty to parry a thrust.

Great Britain has concentrated its fleet in England; Germany in the North Sea and Baltic; France in the Mediterranean, and the United States on its Atlantic

Coast. Each fleet is thus strategically and tactically concentrated to defend the nation's heart, its capital, centres of trade and industry. This defensive conception of the use of the fleet is natural and sound; at the nation's centre of trade lie the great shipyards and markets where material can be readily supplied the fleet. During peace the fleet, being located at the most populous centres, can the better maintain itself in preparedness for war, and can be further made ready upon an emergency in a minimum length of time.

From these home bases of the fleet, situated at the centres of trade, should radiate *Naval Military Roads* extending to the nation's frontiers or to those geographical locations where vital competition or political disturbances demand that the nation have and maintain a voice. On these sea highways must be located fortified naval bases for the use of the fleet in passage. These bases must be stocked with fuel and stores, and should supply sufficiently commodious harbors to berth the entire combatant fleet with its train in security. The distance apart of these naval bases must be such that the fleet, stripped for battle, can steam from one to the next with facility.

This conception is but the idea of the Roman legions and the wonderful network of military roads radiating from Rome to her dependencies.

The road having been drawn to a frontier or to a locality where trade competition is violent, at this terminal is required a base of the first order. From this base the fleet may be called upon to offensively operate against an enemy likewise possessing a base of the first order within that geographical area.

Principles of strategy apply equally to the naval as well as to military campaigns. Therefore in illustration of the principles both the land and sea examples will be used.

The situation of the "Central Allies," Germany and Austria, relative to their opponents illustrates three elements of strategy.

First, there is *Central Position.* Germany and Austria clasp hands, interposing their joined territory between France, Russia, Servia and Italy. The German Fleet, being superior to the Russian Navy, the Baltic Sea is closed to the latter. Germany and Austria thus hold their national power and control concentrated centrally between their enemies. Now that the Near East has been brought under the sway of the Central Allies, more territory has been added; the interposing land running from the North Sea to the Black Sea and the Mediterranean. Russia is completely isolated except via Archangel and the Far East.

Second, by virtue of this central position the Central Allies have had the advantage of interior lines. We have seen with what degree of expedition Germany has moved large bodies of troops back and forth from the Western to the Eastern theatre of war as the exigencies of the moment demanded. Her doctrine of war, so nearly successfully accomplished, was to hold the Russians in check on the Eastern front with a distinctly inferior force and throw the bulk of the German trained troops against the French and English with the object of annihilation and the speedy capture of Paris.

Admiral Mahan thus defines Interior Lines: "The characteristic of interior lines is that of the central position prolonged in one or more directions, thus favoring sustained interposition between separate bodies of an enemy, with the consequent power to concentrate against either, while holding the other in check with a force possibly distinctly inferior."

Interior lines simply means that if a central position is held, it gives the advantage of being able to utilize successfully a smaller force than the total of the enemy so divided by the interposition. The force centrally located can move more quickly to either front than the enemy opposing it.

A maritime example of these two elements of strategy was the Japanese Fleet under Admiral Togo at the Elliot

Islands, holding the *central position* and on *interior lines,* to the Russian Port Arthur detachment and the Vladivostok detachment. Another is the German Fleet in the Kiel Canal interposing and holding the central position and on interior lines to the British and Russian Fleets in the North Sea and Baltic respectively.

That Germany was thoroughly alive to the economy of force consequent upon holding the interior line to her probable enemies the following footnote, written by the late Admiral Mahan in "Naval Strategy, 1911," reads prophetic: "An interesting instance of the method and forethought which cause German naval development of all kinds to progress abreast, on parallel lines, is found in the fact that by the time the three dreadnoughts laid down in 1911 are completed, and with them two complete dreadnought squadrons of eight each, which probably will be in 1914, the Kiel Canal will have been enlarged to permit their passage. There will then be a fleet of thirty-eight battleships, including these sixteen, which will be stationed, eight in the North Sea, eight in the Baltic, linked for mutual support by the Central Canal."

The enlargement of the Kiel Canal was actually completed a year earlier and the fact celebrated with great naval pomp and ceremony.

"*Communication*" is defined by Mahan as "designating the lines of movement by which a military body, army or fleet, is kept in living connection with the national power." Communications are the arteries supplying blood to the limbs of a military or naval force. Once these "communications" have been severed by an enemy, new lines must at once be found, else the army starves and the fleet goes derelict.

Communications are defensive in character and must never be exposed to the enemy's attack. When the expedition into Mexico to punish bandits penetrated some three hundreds miles south, General Pershing's communications were along a single-track railway or over bad roads by motor trucks. To guard these communications in order

that food and war supplies, also reënforcements, might arrive promptly and not be jeopardized *en route* by bandits or disaffected Mexicans, required several thousand soldiers scattered in small detachments along the route from the border to the army. This line being thin was everywhere weak and was liable at any time to an attack in force upon a relatively small part of its whole. In this case Pershing was surrounded by a possible enemy who would upon the outbreak of hostilities attack his communications with the object of cutting off supplies and reënforcements.

By holding the central position and on interior lines, with communications safe from the enemy's attack, by having communications to either front lying behind the front and covered by the military forces at the front, all advantages of position are secured.

Communications are most " tender." In the Japanese-Russian War, the Russian Fleet in the stronghold of Port Arthur threatened the Japanese Army's communications to Manchuria. Port Arthur was central as regards Japan and Liao-Yang or Mukden. The Port Arthur naval detachment held the central position as between Japan and the safe landings in Manchuria, while the Russian Army in Port Arthur held the central position as between these landings and Liao-Yang or Mukden. It became then imperative for Japan to " contain," that is, " bottle up," the Russian Port Arthur naval force and besiege by land the army stronghold.

Long lines of communications across the ocean can be rendered secure only by large numbers of fast fighting ships. In a war carried to the Caribbean, a European power would require a large number of armored or battle cruisers and fast scouts to safeguard the communications from the mother country to its fleet in the Caribbean. The same types of ships are necessary for the purposes of cutting this line of communications, thereby cutting off from the far distant fleet its supplies of food, stores, fuel and men.

"Be always stronger than the enemy at the decisive point," is a principle that requires no illustration. Strategy permits a force to divide, provided concentration can be effected in due time to receive or make an attack.

The possession of the strategic points decides the success of the operations of war. "War is a business of position," was Napoleon's way of expressing this important truth. A study therefore of strategic points and their acquisition is a natural corollary of sea power. This is a study requiring the best expert brains of both our army and navy, aided by our statesmen. It is a political act of the greatest importance during peace. It must not be an act of partisan politics. Strategic points of the first importance to the nation may lie in the district of a Congressman or even a Senator with no influence whatever in the military and naval committees of Congress or on the floor of either House, while points of no strategic value may lie within the district of men powerful in the National Legislature. Is Congress endowed with patriotism of such a high order that the influential men will say to those without influence: "The military and naval experts have decided that your harbor is of great strategic importance to the nation; that it may be the key to the situation in war; therefore, it must be developed into a great base for our fleet. I will vote for a large appropriation for this purpose. True, I thought some of the harbors in my state should be developed for military and naval purposes, but the experts say no. I am willing to abide by their decision, for it is based upon expert knowledge and long study of the things with which I am unfamiliar—my constituents will be disappointed, but I shall find means to show them the justice of my act, and I am sure they are sufficiently patriotic to want the government's money spent where it will do the nation the most good"?

That this is unhappily not yet possible is too evident when we consider the amount of money spent annually on harbors for commercial and naval purposes which in

time of war would not be used, and in peace are seldom used.

Guam, Culebra and Key West are examples of strong strategic points, so decided by our most expert strategists, which lack the support of influential legislators.

Admiral Mahan points out that the strategic value of any place depends upon three principal conditions:

"*First.*—Its position, or, more exactly, its situation. A place may have great strength, but be so situated with regard to the strategic lines as not to be worth occupying.

"*Second.*—Its military strength, offensive and defensive. A place may be well situated and have large resources and yet possess little strategic value, because weak. It may, on the other hand, while not naturally strong, be given artificial strength for defense. The word fortify simply means to make strong.

"*Third.*—The resources of the place itself and the surrounding country."

In explanation and illustration of these three conditions as affecting the selection of strategic points, the group of islands of which Porto Rico is the largest, and including St. Thomas, might be used to advantage. It is a salient point and commands the eastern entrance to the Caribbean. A fleet based there would be at the most advantageous point for attacking an enemy fleet bent upon securing a foothold inside the Caribbean or upon the destruction of the Panama Canal. If the enemy from across the Atlantic had established himself upon the north coast of South America or upon an island of the Caribbean, then from this position our fleet could effectively cut the enemy's communications. In this connection it will be seen to be centrally located and on interior lines to forces using the Windward Passage and the Leeward Passage into the Caribbean.

It can be readily fortified and made impregnable by the expenditure of less money than the cost of one dreadnought.

Its natural resources are great and these can be added to as desired.

The recent desire for the acquisition of St. Thomas may portend the determination to make this position secure. It will become in any naval war waged against us in the Caribbean the decisive point or position. It therefore is good strategy to make ourselves secure in it during peace.

Strategic lines are the lines joining strategic points. Where several strategic lines intersect near an island or a commodious harbor, at this point we are safe to establish a naval base, because we have located a strategic focus.

"Navies depend upon maritime commerce as the cause and justification of their existence." "The interests of nations in the sea are almost wholly interests of trade—of carriage."

Our naval strategy, then, must be so conducted as to give our maritime commerce protection. Ships and men alone are not sufficient. We must in addition select and secure the important positions. A position important commercially must also be important to a fleet. The foci of trade routes, and points where trade routes converge or diverge, are important strategic positions which should be secured by the nation during peace that desires to maintain its commercial holdings. These points in the hands of a rival competitor will eventually cause all other nations' commerce to dwindle and disappear.

Examples of trade "foci" in the Pacific are Guam and Honolulu. Malta is such a focus in the Mediterranean and Bermuda in the Atlantic.

Panama, Singapore, Gibraltar and Key West are points where trade routes converge and diverge.

The great Jomini gives the following advice to students of strategy: "In arranging a plan of operations, remember that a strategic theatre as well as every position occupied by an army (navy) has a centre and two extremities; or three zones—right, left and central.

"In choosing a zone of operations select one:

"1. That will furnish a safe and advantageous base;

"2. In which the least risk will be run by yourself, while the enemy will be most exposed to injury;

"3. Bearing in mind the antecedent situation of the two parties;

"4. The dispositions and inclinations of the powers whose territories are near the theatre of war;

"5. Next determine the objective—either geographical and territorial or in the destruction or disorganization of the enemy's force (and his maritime commerce) without considering geographical points;

"6. Operate on interior lines."

CHAPTER V

MILITARY CHARACTER

"A HIGH moral courage capable of great resolutions. A physical courage which takes no account of danger. A man who is gallant, just, firm, upright, capable of esteeming merit in others without jealousy,"—this is Jomini's definition of a leader of men.

The great leaders each possessed moral power and intellectual power to a high degree. Of the two, moral power is by far the more important. Moral power, or strength of character, is usually a product of heredity and early training.

For a military leader qualities of character that have the greatest weight are decision and good sense. He must have clearness in conception and energy in execution. History offers many examples to show that after decision one of the qualities of leadership which contributes the most to success is stubbornness.

Napoleon was fond of declaring to his less decisive commanders: "Before conceding the victory let us wait until it is snatched from us. Before retiring let us wait until we are forced to do so."

John Paul Jones on board the sinking "Bon Homme Richard," engaged in a death struggle with the "Serapis," when asked if he had struck, stubbornly answered: "I have not yet begun to fight." Moral power won for him the victory.

General Grant betrayed this important characteristic of military character when he announced, "We will fight it out on this line if it takes us all summer."

A leader, to be able correctly to use his natural moral power, must be thoroughly versed in his profession, and thus obtain the necessary confidence in his ability to suc-

ceed in any undertaking. Knowledge alone is not enough; he must have frequently applied his knowledge to cases; in other words, solved and executed problems dealing with the elements and principles of his profession.

Napoleon, before his campaign in Italy, had thoroughly trained his mind for war, yet he had not acquired that supreme self-confidence which afterwards made him the boldest leader of history. This boldness came to him gradually through the practical experience of handling armies in the field. It was not until the great victory at the bridge of Lodi that he fully realized his great ability as a general, and gained a self-confidence that seemed impossible of resistance.

"The Articles for the Government of the Navy," popularly known as the "Articles of War," define the standard of character of a "Gentleman and a Naval Officer" in the following words:

"The Commanders of all fleets, squadrons, naval stations and vessels belonging to the Navy are required to show in themselves a good example of *virtue, honor, patriotism* and *subordination.*"

Possessing these four cardinal qualities of character will not assuredly produce a leader, yet they are necessary ingredients in leadership. No man can be a truly great leader without all of them.

Virtue signifies the quality of manliness, manly strength or valor, courage, bravery. Can anyone doubt that Cæsar, Hannibal, Alexander, Nelson, Napoleon, St. Vincent, Farragut, John Paul Jones, Sampson or Dewey lacked these?

"Add to your faith virtue and to your virtue knowledge" is an excellent receipt for military character. Also bear in mind that "The brave man is not he who feels no fear, but he whose noble mind its fears subdues."

A famous military leader when going into battle could not control his legs, which shivered so as to make him fear others would observe them and believe he was afraid. He is *said to have* been overheard saying: "Tremble, legs,

but if you only knew where I am about to take you, you would give way under me."

Virtue demands strong spirit and precludes the weak and vicious; it produces the kind of men that command respect and attention everywhere and at all times. With virtue as a foundation *honor* erects a high sense of duty. It gives the possessor a subconscious understanding of what is right and just. From honor, loyalty, fair dealing and faithfulness to trust naturally flow. Honor causes a person in the performance of a duty not to look for reward or punishment, but to scrupulously execute the task for the task's sake.

Patriotism is the motive binding us all together in one great cause. It gives unity to action. The virtue in the civil administrators, the heroism and self-sacrifice of the soldiers and sailors, flow from a custom acquired by men of considering their nation as an entity. They delight to identify themselves with its fortunes, share in its triumphs, and mourn in its disasters; ever looking to a future when the nation's destiny will be fulfilled. This noble idea of "Country" represents a heritage of sentiments, of traditions, of thoughts, of common interests. Patriotism is fundamental. We must learn in our childhood to cherish and defend this most sacred of all national ideals.

A nation in whose citizens the virtue of patriotism is securely implanted is of consequence strong, vigorous, progressive. Without this ideal, a nation will be weak and spineless—two traits of national character which inevitably lead to national death. Patriotism becomes a passion which burns undiminished. It exerts the strongest influence for unity; it is the moving force in war; it is the ideal for which sailors and soldiers cheerfully die, their beloved national anthem upon their lips.

Patriotism has its root in the dark ages when a community existed only on the condition that one portion of the inhabitants stood guard while the remainder *worked* in the fields. There was always the risk that an

attack from an enemy might come suddenly upon a weak spot in the defense and overwhelm it. To prevent annihilation of the tribe, therefore, the soldier guards were called upon to fight to the last man in order to give time for their comrades, scattered in the fields, to come to their support. It was in this manner that the idea of self-sacrifice for the good of the greater number first had its origin and is the bed-rock foundation to-day of the soldier's and sailor's calling.

All great leaders understood the power of patriotism and seldom missed an opportunity to arouse it in their followers. If an army or a fleet is blessed with a true leader, patriotism often centres around the personal magnetism of that leader. He becomes the embodiment of the ideal of patriotism. It is said that Napoleon's presence upon the battlefield, in the effect it had upon the morale of his soldiers, was worth 30,000 men. Nelson was given the value of three ships of the line.

Subordination, the quality or habit of obedience, is indispensable in a military service. Subordination is an essential quality to regulate the relations of subordinates to their leaders. Without subordination in a community chaos will reign supreme.

Burke glorifies this attribute of good citizenship in words so stirring as to appeal to every patriot: "That generous loyalty to rank and sex; that proud submission; that dignified obedience; that subordination of the heart, which kept alive, even in servitude itself, the spirit of an exalted freedom."

These are the ingredients of leadership, yet to lead, strong *will* is a further essential. "Sway over others is before all else founded upon *will.* The one who knows best how to give the most definite expression to his will leads. A demand made with determination seldom meets with opposition. It has something impressive in it for those who are to obey, from which they attain a sense of personal security, and this enhances their courage and capacity."

Strong will must be coupled with self-confidence. Self-confidence has the courage of its convictions. Once the mind is made up, there is no faltering in the execution. The self-confident mind is clouded with no doubts or fears of the result; it acts with promptitude and decision.

Virtue, honor, patriotism, subordination, will, self-confidence all go to make up military character. Yet there is another and most important attribute for leadership; it is the "willingness to take responsibility."

"The courage of responsibility is a glorious and divine gift, which alone enables a high-placed general to achieve great results; for, if his experience and intelligence are not sufficient, he finds shrewd helpers to supply his deficiency. Courage of responsibility is born of a certain magnanimity which must be inherent in the general, and which ennobles his whole nature. It is a feeling of superiority which elevates without making presumptuous. It is moral courage and strength of mind in high development, schooled to endure the severest trials without unsettlement of the power to reason clearly, and without swerving from the great end in view. Thorough knowledge enhances security, steels self-confidence, and so gives calmness under responsibility. Ignorance and uncertainty undermine it, destroying the power to act with decision under stress."—*Von der Goltz.*

Every leader worthy of the name must be prepared to accept responsibility for the acts of his subordinates.

Ambition, the soldier's virtue, is a valuable military attribute. It is the desire to excel, to be *first,* and with it there will be continuous and unflinching effort to succeed. "Great deeds are impossible without ambition."

Other contributing attributes to leadership are patience and resolution in order to "meet with triumph and disaster and treat those two impostors just the same."

Imagination puts the crowning glory upon the head of a leader. It is the creative force. Napoleon attributed his inspirations to memories called up by his imagination.

"Will, ambition and a love of fame, blended with crea-

tive powers (a trained and imaginative mind), result in an irresistible activity."

The most important duty that falls to a nation is the selection of its leaders. More especially is this true for the military services. In a democracy men rise to power more frequently by reason of other attributes than character. In our military and naval service the method has been by seniority, varied by a modicum of selection in assignments. Such methods can give only average ability. Leaders so made are frequently past the age when the spark of genius burns brightest. Initiative has been long stifled, and decision of character dead from long disuse.

A naval student of military character, in elaboration upon Napoleon's often quoted saying that "in war the moral is to the physical as three to one," arraigns his fellow officers for not profiting by the historical lessons before them. He says:

"Military history teaches that in nearly every battle, character, morale has been the determining factor. We accept the statement readily. But the remarkable fact is that in spite of the known determining value of superior morale, of superior military character, and especially of the value of superior military character in those who command, no systematic and continued effort has been made in our service to examine the ways of creating superior morale, of creating a high average of military character in the service."

We understand academically the several attributes which go to make a leader of men, but we seem to take for granted that these factors are innate and cannot be developed. That this is not true has been shown by many writers on military history.

Military character is a product developed by gradual and prolonged application. It does not shine forth except after profound studies and in its beginnings, like every creature that tries to walk, it is obliged to follow a guide on whom it leans. The true genius differs from other men in this, *that he* may soon dispense with his guide to

become in his own turn a creator. Yet a genius never ceases work on his own mind. He constantly builds by the untiring effort of a will that has an end in view.

A study of the life of Napoleon shows that his genius was so developed. Education, the will to learn, the concentrated life-long effort, the clear perception of the mission, the application of the knowledge and experience gained, all joined in an individual of exceptional attainments, served to produce the greatest military genius of modern times.

If such a genius found such measures necessary; if he had to endure the labor of preparation to insure achievement, no man can be justified in believing he can succeed with lesser effort.

Education first of all must ever be considered the foundation for genius, the principles underlying cause and effect; a clear comprehension of past events. With these there must be a precise formulation of one's own ideas, and lastly exercise in application.

"A given force to be most effective must be applied as a whole at a point where the effect will be the greatest."

This is merely a law of physics, but it holds equally true as a tactical principle of unity of concentration.

In order that a military force, a fleet of warships of many types, may be led into battle a unified force, its efforts directed by many individuals yet with maximum effectiveness, what qualities of character are required in the leaders?

Unity stands out predominantly as the first essential. Scattered or conflicting effort is wasteful. This will be readily conceded by all. Yet to achieve unity the free acceptance of leadership is the prime requisite, and how difficult this is to the mind of those who have not been bred in a military atmosphere! Even within the services free acceptance of leadership is rarely attained.

The free acceptance of leadership means loyalty to the plan of the leader.

After unity of effort has been gained—the effort must

be continued until the end has been reached. For this decision of character is demanded of the leaders. An action once begun must not be abandoned. A pause or a change of plan through indecision robs the blow of the greater part of the force.

Military and naval operations require more than mere loyalty. In a large mixed force of battleships, cruisers, scouts, destroyers, submarines and auxiliaries, going into action against an enemy's fleet, there is no time for the supreme leader to attend to every detail of the impending battle. Subordinates must appreciate the situation and act appropriately for themselves. It is therefore evident that in war the forces of mentality and character enter most frequently and are the dominating forces. Subordinate leaders must act to oppose the enemy at every point. To do this effectively they must act upon their own initiative. Not independently, but in coordinate effort. The quality required is called "trained initiative." It must be based upon knowledge—knowledge of their profession and the plan of the supreme leader. Trained initiative implies loyalty, not a mere personal loyalty, but a loyalty to the plan, to the end to be accomplished.

"Whoever is loyal, whatever be his cause, is devoted, is active, controls himself, is in love with his cause, and believes in it."

Loyalty aims at unity. Full knowledge is a necessary essential for true loyalty. A subordinate leader with full knowledge of the plan of the supreme leader uses his trained initiative and loyally furthers the aims of his chief. The aim, the end to be reached, must ever be held before his mind's eye; an act which does not further that end is disloyal.

Loyalty to the supreme leader must be coupled with loyalty from that leader to all his subordinates.

Napoleon's "system" meant merely that his subordinate leaders thoroughly understood the plans, intentions, strategy and tactics of their chief. They had been

indoctrinated and taught by Napoleon himself; the workings of Napoleon's mind were plain to such soldiers as Davout, Bernadotte, Lannes and Murat. They possessed the trained initiative coupled with loyalty to act for the furtherance of Napoleon's aims. "A word to the wise is sufficient." Each understood the "system," and they by united and continued effort, without restricting directions from their chief, won for him Austerlitz, Jena, Wagram. Napoleon was loyal to such captains. When he ceased to be loyal, when through mistrust in their loyalty and ability he failed to make known his plans, then his "system" broke down and battles were lost. Even the genius of Napoleon could not give directions at every point of a battlefield, and subordinate leaders cannot act to further a plan whose end in view is not known nor understood. "They do not understand my system," Napoleon is quoted to have said. Why? Because he had not freely confided in his subordinates. No man can be fully loyal either to a cause or a plan without a full understanding of it. The desire to be loyal is insufficient; it must be augmented with knowledge to guide loyal effort.

Loyalty naturally involves a surrender of a measure of individualism. Proper loyalty in the military sense should not lessen individual worth, but, on the contrary, should enhance it.

Self-assertive independence is suppressed, but individual judgment and initiative find themselves encouraged.

To be great within his own authority and prepare for being great in a higher area should be the true aim of loyalty.

To inspire his subordinates with loyalty, a leader must have their full confidence. He must instruct them thoroughly and carefully in his plans of action, feel sure that each one understands them clearly and that all know what results are desired, what end is in view. And in addition to this and equally as important, he must let his *subordinates feel* his confidence in them and fully realize the

limits of their own authority in order that they can be prepared to act with promptness and decision.

The following is quoted from a paper written by a young lieutenant of the fleet upon loyalty. It is particularly interesting in view of the intimate knowledge of conditions portrayed:

"We have all seen unexpected failures of ships officered by capable men that could only be explained by a lack of team work. Conversely, in seeking the secret of some very successful ships manned by officers of only average abilities, we could only conclude that they had merged their efforts. Who has not seen the divisional officer who could not look beyond his own division? Who has not seen the chief engineer who, immersed in his own department, failed to consider the ship as a whole? A most vital tactical error is to send one's forces into action piecemeal; similarly, disjointed action in the everyday affairs of the ship will certainly ruin her."

A condition such as might exist on board ship through disjointed action of subordinates must be laid at the captain's door. He has failed in his loyalty, either through sheer laziness or else through lack of confidence in his subordinates, in not making plain his plans and his aims and encouraging his subordinates to join him as subordinate partners in a common cause.

Decision of Character.—We have frequently heard it said of men in high places, "He lacks decision of character." What do we mean to convey by this expression? "Sway over others is before all else founded upon WILL. He who knows best how to give the most definite expression to his will leads." This is axiomatic and the description fits our expression "decision of character." Knowledge re-enforced by practice, thoughtful consideration, a decision and then *will* or stubbornness in execution,—that is decision of character, and he who possesses it will rise high in a military profession. In the navy there is no place for an indecisive man. He is a destroyer of unity, of confidence, and he fritters away valuable time. He

dissipates his own energy and the energy of his subordinates through "resolutions adopted, rejected, resumed, suspended."

Who is there who cannot recall such indecisive characters—a man occupying a position of responsibility and trust who could not give a decided answer to the least important question where action was concerned? Instead he would hide behind such answers as "I'll think it over" or "I'll take it under consideration."

Decision of character is the habit of dealing with each situation as it arises with a prompt, clear and firm reply as to what shall be done and the manner of doing it. It is a habit and requires cultivation by practice.

In the cultivation of this valuable habit, a habit most important for any man who is in a position of responsibility, no matter how unimportant the position may be, the first thing to consider is, "What is the task?"; then, "What are the obstacles in the way of its accomplishment?"; further, a knowledge of and a careful weighing of the means at hand for overcoming the obstacles. The reasoning mind by a method of pure logic is then ready to give the reply. This process of reasoning is long and laborious to the novice, who has not the knowledge of either the obstacles or the means at hand of overcoming them. Knowledge and practice overcome these difficulties. A trained mind can "estimate a situation" with the speed of thought; his "decision" or reply comes so quickly after the question is put to him it would appear almost that he had rendered his reply without reasoning. But such is not the case; his mind "short circuits" from the recognition of the task to the decision as to the manner of its accomplishment merely because the mind is trained. The reasoning becomes subconscious and such reasoning has the speed of light itself.

"The man who seeks decision of character should decide knowingly if he can, ignorantly if he must, but in any case he should decide."

Initiative is of two kinds: (1) The power to make

starts. (2) To act upon one's own responsibility in order to help the cause of the Chief.

These two should not be confounded; it is the second which is of most importance in a military service. It is called *trained initiative* and has been casually discussed above. We are now going to elaborate more fully upon the fundamental attribute.

Thorough and systematic study, education, in other words, in order to be able to grasp the principles of the art of war, naval or military, must be the base rock foundation upon which this initiative can be built. Without a clear understanding of these principles, initiative must inevitably lead to a disorganizing independence.

We all know that a boy of eight or ten years cannot be given complete initiative; why? Because the moral and material principles of life have not yet been learned. If we could confine his experiments in initiative in reasonably shallow water, and near enough home, it would be the most salutary experience for him to let him take his own risks and get, figuratively speaking, capsized. Thus he will learn the wind's treachery, the water's danger and discomfort and his own poor judgment and insufficiency without losing his young life, or, what is worse, his developing character. He needs to buy as cheaply as possible the necessary experience of failure which will tone down his wilfulness, develop his caution, cultivate his dexterity in handling his own craft (himself), practise his judgment and his quickness of decision, and giving him thus a working knowledge of the world.

For the navy, and those who will join in time of war, this initiative must be acquired in time of peace through frequent practice.

It is a very old saying that "We learn from our failures, not our successes." No one should be ashamed of a failure that occurred through a lack of knowledge, which was through no fault of his. Yet do not depend upon learning the many lessons through the failures of

yourself alone; profit by the failures of others. This was the method of all great leaders.

We have seen that as a base foundation for the development of military character we must obtain our knowledge of war from both historical study and experience during peace. •In war, character comes to the front quickly, but in peace many officers having the qualities of great leaders lie fallow, awaiting only the call of opportunity.

CHAPTER VI

NAVAL TRADITIONS

What a magic word is this! What a momentous factor traditions play in the military services! It is an ideal to be scrupulously preserved by the old and a living inspiration for the young. A navy without traditions is like an individual with character undeveloped: it has neither safe moorings nor a compass to direct its course through the seas of obscurity. Like a rudderless ship it falls to the mercy of idle winds that blow "whither they list."

The wealth of traditions clung to so tenaciously by the British Navy has been its "shield and buckler." The inspiring deeds of Drake, of Rodney, of St. Vincent, of Nelson, and of many more British seamen have given to that navy a consciousness of superiority beyond the possibility of accurately estimating. These traditions of heroic service have become the guiding genius of the British Navy. They are a confession of faith; examples of high patriotic duty and sacrifice to be emulated by every officer and man wearing the King's uniform. Traditions such as these cause ships to sink with their colors nailed to the mast, to the last in a death grip with their opponents. They give added courage to the brave and turn timidity into boldness.

The cruise of the American Commodore Rodgers during the War of 1812 was far greater in material productiveness than the victory of the "Constitution" over the "Guerriere"; yet this latter feat of American naval arms in creating an immortal tradition, not only for the navy but the country, far outclassed in importance all naval exploits up to that time.

How tenaciously a nation clings to the remembrance

of the heroic deeds of its sons, guarding them against oblivion by story, verse and song!

The young, early in their career, are taught the inspiring stories of the most noble of their race. Washington, Paul Revere, Nathan Hale, Decatur, Isaac Hull, Phil Sheridan, and Lincoln have been woven into the very fibre of the youth of this nation. Here are illustrious examples of self-sacrifice, bravery and devotion to the nation that should cause even the sluggish blood of old age to course faster and make youthful hearts beat tumultuously.

Germany has many noble traditions of the war valor of her sons on land, but at the outbreak of the present war the Kaiser's navy could boast of naught save a marvellous efficiency during the years of peace. The German Navy in spite of its great size and formidableness had yet to develop character, to create traditions, to put into the mighty fleet a soul.

Von Muller in the "Emden," Von Spee with his squadron of cruisers, gave to the German Navy its first illustrious examples of incomprehensible bravery and heroic sacrifice on the seas. The German submarine activity furnished a further proof that the officers and men of that navy had the superlative boldness and confidence to operate amidst a thousand perils. It has been claimed by a British writer, that German "submarines went out and never returned, other submarines went out, perplexed, against a mystery, and these, too, never returned, or returned in mysteriously diminishing numbers." Sunk by mines, caught and suffocated in steel nets, trapped on the surface and sunk by gun fire, not one whit undaunted, the German submarine still stealthily attacks both warships and supply ships of its enemies. They are making traditions for the German Navy; showing their enemy the almost foolhardy courage and self-sacrifice of Germania's sailors. These illustrious deeds now have put new life and an exalted spirit of *emulation* into the personnel of the German Fleet.

Japan, although a warlike nation, with a military caste, ranking first in the kingdom, could advance no traditions of heroic conduct or extraordinary valor in a war with a white nation. Her traditions were made and handed down from the many wars with China and Corea and from frequent internal strifes or rebellions. A standard of valor in a war with a white race had yet to be established. The Japanese were uncertain of the war valor of their navy or army against a European nation. Military men realized the extreme importance of this moral power and their greatest desire was to create these traditions through war acts which appeared to onlookers as almost foolhardy recklessness. The impetuous night attacks of her destroyer flotillas and the charge of the Japanese Army Corps across the Yalu River furnished at the start of the war with Russia the ideals of patriotic sacrifice and victory which the Japanese sailor and soldier needed to give him the moral power to fight successfully the most populous white nation of Europe.

There are traditions of the Naval Service, not as inspiring yet equally as important, for the officers and men comprising our fleet: The claims of discipline regulating the relation of the officer to the enlisted man; the reverence for rank; a high ideal of duty; the navy's efficiency before all else; a jealous resistance against outside and unskilled domination; these beliefs have been handed down through successive generations of officers and men.

The officers, being the more permanent and of necessity the more highly educated, have been the guardians of these traditions.

There is no safe passport to high place in a naval service save virtue and wisdom. Edmund Burke has given us his views on the qualification for command in the following words: "Woe to that country that considers a low education, a mean, contracted view of things, a sordid, mercenary occupation as a preferable title to command. Everything ought to be open, but not indifferently, to every man. No rotation, no appointment by lot.

no mode of election operating in the spirit of sortition or rotation. . . . I do not hesitate to say that the road to eminence and power from obscure condition ought not to be made too easy. . . . If rare merit be the rarest of all rare things, it ought to pass through some sort of probation. The temple of honor ought to be seated on an eminence. If it be opened through virtue, let it be remembered, too, that virtue is never tried but by some difficulty and some struggle."

The claims of discipline seem oftentimes trivial and unnecessary to the civilian. Saluting, standing at attention when spoken to by a superior in rank, adding the "Sir" to an answer to a question from a superior in rank, all are merely an outward expression of loyalty and respect for rank. They are and always must be retained in the military services. It is no more disgrace for a sailor to salute his officer and stand at attention when spoken to than for a son to give the same deference to his own father. Both are showing reverence, not to the individual man, but to the higher wisdom or the wider experience of age.

"In schools and colleges, in fleet and army, discipline means success and anarchy means ruin."

Discipline is accomplished through a course of exercise and practice in order to bring and keep under control, and to qualify for harmonious and effective action.

Again we see the necessity for unity in action. To gain unity each part of a whole, an army or a fleet, must act harmoniously and in accord with the demand of a single will, that of the leader. This can be accomplished only by discipline.

It cannot be too often reiterated that morale in a military service is far more important than any other factor; in fact, more important than all other factors combined. Morale is a product of all the military virtues. Tradition is no small part of morale. A navy or a nation whose past is full of great achievements, of heroic examples of self-sacrifice, of victories won over vaster num-

bers and against more powerful material, will hold a high trust to keep that record unblemished.

To show the historical truth that higher morale wins battles, the most important sea fights have been tabulated (see pages 52–55).

Neither size nor numbers have been the deciding factor in the sea fighting of the past. The side having higher morale and in consequence holding a conviction of victory by attacking their enemy in forty-three battles, won in thirty-six battles and fought three indecisive actions. This conviction must be attributed to a recognized moral fitness to engage and win which the other side, the loser, did not possess in sufficient quality. Historians seldom take account of the moral factors involved, usually attributing victory to a material superiority or an especially brilliant display of strategical or tactical skill. This merely emphasizes the means employed by the more fit to overcome their enemy. The fourth dimension in warfare is the conviction of victory, almost always held by the victors long before the battle. It is based upon a belief in the virtue and bravery of their ancestors, a thorough trust in the leaders and their companions in arms, on the virtue of their government, upon the known integrity of their material; in a word, upon the belief in the higher efficiency of their organization for war and battle.

"The Book of War," a Chinese classic, written several thousand years ago, says:

"The army (navy) which conquers makes certain of victory and then atacks, while the army that is defeated fights in the hope of success."

Date	Battle	Side Superior in Numbers	Side Superior in Size of Ships	Side Attacking	Victor	Remarks
431 B. C.	Naupactus	Peloponnesian	Peloponnesian	Athenians	Athenians	Greater tactical skill.
424 B. C.	Ægospotami	Peloponnesian	Peloponnesian	Peloponnesian	Peloponnesian	Athenians caught with ships on beach and crews inland for food.
414 B. C.	Syracuse	Syracusan	Syracusan	Athenians	Syracusan	No room for Athenians to show nautical skill.
410 B. C.	Cyzicus	Peloponnesian	Peloponnesian	Athenians	Athenians	Nautical skill and stratagem of Athenians.
	Messana	Carthaginians	Romans	Carthaginians	Carthaginians	Superior nautical skill of victors.
257	At sea	Romans	Romans	Carthaginians	Romans	Use of the Corvi.
256	Tyndaris	Romans	Romans	Romans	Romans	Superior tactics of Romans and Corvi.
	Mount Ecnomus	Romans	Romans	Carthaginians and Romans	Romans	Superior numbers.
	Cape Mecurius	Romans	Romans	Romans	Romans	Superiority of Roman ships.
255	At sea	Doubtful	Romans	Carthaginians	Carthaginians	Romans were hampered by a great convoy.
	Drepanum	Romans	Romans	Carthaginians and Romans	Carthaginians	Clever tactics of Carthaginians.

241......	Lilybæum........	Carthaginians	Romans....	Romans....	Romans....	Romans' superior skill; Carthaginians encumbered with stores.
218to202	Lilybæum........	Romans....	Romans....	Romans....	Romans....	Use of Corvi by Romans.
	Carthagena.......	Romans....	Romans....	Romans....	Romans....	Carthaginian ship hauled upon beach.
	Off Italy.........	Romans....	Romans....	Romans....	Romans....	Superior numbers.
	Off Tunis........	Carthaginians	Romans....	Carthaginians	Carthaginians	Superior numbers.
	At sea...........	Carthaginians	Romans....	Carthaginians	Carthaginians	Superior skill and numbers.

Date	Battle	Superiority		Side Attacking	Victor	Remarks
		Numbers	Size of Ships			
31 B. C.	Actium	Antony	Octavius Cæsar	Octavius Cæsar	Octavius Cæsar	Demoralization of Antony's men.
1571	Lepanto	Turks	Venetians	Turks	Venetians	Better skill and higher morale.
1588	Spanish Armada	Spanish	Spanish	English	English	Higher nautical skill of English.
1666	Four days	Dutch	English	Dutch	Dutch	Superior strategy of Dutch.
1672	Solebay	English and French	English and French	Dutch	Dutch	Superior nautical skill.
1676	Stromboli	French	French	French	Dutch and Spanish	Battle indecisive, but French were badly handled by enemies.
1690	Beachy Head	French	French	English and Dutch	French	Skilful tactics of French.
1744	Matthew's Action off Toulon	English	French and Spanish	English	English	Battle indecisive, due to inefficiency of most of English captains.
1759	Hawke and Conflans	English	French	English	English	Skilful tactics of English.
1788	Ushant	Equality	French	English	Indecisive	French withdrew.
1780	Rodney and DeGuichen	French	French	English	English	Superior tactical skill of English.
1781	Suffren at Porto Praya	English	French	French	Indecisive	Suffren was not supported by his captains. English suffered greatly.
1782	**Suffern and Hughes**	**French**	**French**	**French**	**Indecisive**	**French had best of action.**

1782....	Suffern and Hughes	Equality...	French.....	English....	English....	Disaffection and incompetence of French captains.
1782....	Rodney and De-Grass, Battle of The Saints	Equality...	French.....	English....	English....	Superior tactics and nautical skill.
1797....	Aboukir Bey, "Nile"	French.....	French.....	English....	English....	Superior tactical skill.
1805....	Trafalgar........	French and Spanish	French and Spanish	English....	English....	Superior tactical skill.
18.......	Lissa............	Italians....	Italians....	Austrians..	Austrians..	Superior tactical skill.
1894....	Yalu............	Equality...	Chinese....	Japanese...	Japanese...	Superior tactics and gunnery
1898....	Manila Bay......	Equality...	Americans..	Americans..	Americans..	Superior tactics and gunnery
1898....	Santiago.........	Americans..	Americans..	Americans..	Americans..	Spanish endeavored to escape from harbor of Santiago, made only feeble effort to fight.
1904....	Round Island.....	Japanese...	Equality...	Japanese...	Japanese...	Superior tactics and gunnery Russians endeavored to elude Japanese and get to Vladivostok.
1905....	Tsushima........	Russians...	Equality...	Japanese...	Japanese...	Superior tactics and gunnery Russians endeavored to escape action.
1914....	Caronel..........	Germans...	Germans...	Germans...	Germans...	Superior ships and gunnery. Germans had more heavy guns.
1914....	Falkland Islands..	English....	English....	English....	English....	Superior gun power and speed.
1915....	Dogger Bank.....	English....	English....	English....	English....	Germans retreated, losing one ship.

CHAPTER VII

NAVAL TRAINING

WHAT is the purpose of naval training? The correct answer, thoroughly understood and applied, was a necessary factor before the course of training for officers and men of the navy could be outlined.

The most important purpose of training for the military services is that of character building. A high sense of duty, painstaking care in the performance of a task, individual responsibility, trustworthiness, loyalty to the purpose of the navy, these are the elements of character most desired. Expertness and knowledge without the above elements are ineffectual. Training has for its purpose the intelligent subordination of individual wills into a higher will, that of the representative of authority.

A loyal, ignorant sailor is of more value than a disloyal genius.

A warship is so complex in its constituency that there is required a large variety of special trades among both officers and enlisted men. There must be subordinate heads to each specialty. Each subhead is in fact a prince within his own domain. The organization and the work of directing the men under him are his special duty. At the head of this collection of specialists is the executive officer of the ship, who in the internal management of the ship receives his authority from the captain. Each and every officer and man on board ship finds himself with a proportionate daily task to perform; each will receive direction as to the performance of the task if need be, but those with sufficient expertness, initiative, and loyalty will perform that task to the utmost of their ability without waiting for specific directions. To have a crew of officers and men who will recognize their task and individually perform it, yet keep always in mind the part

their task bears to the other tasks and to the ship as a whole, is the object of naval training and the true goal to success.

Officers and men having the knowledge and expertness who, through defective character development, slight their tasks or perform them indifferently, are individuals that a ship can well afford to neglect.

Insufficient training, where character has been left undeveloped, produces officers and men who are irresponsible. They take no care of government property entrusted to their care, and frequently through neglect endanger the ship and the lives of thousands of men.

Too much stress cannot be laid on this vital part of training. Both officers and men should be taught the precious gift of responsibility early in their training. The hand of guidance should be very lightly felt and entirely removed when the person under training feels that he is able to steer his craft himself. If officers or men feel that they are closely followed up in their work and will be corrected at every turn by an instructor, they will learn to look for this guidance always. The consequence will be irresponsibility; the very thing training is endeavoring to avoid. Give the student a task and tell him or teach him how it can be done and point out the aim, then leave him to fight the battle out alone. He will frequently enough improve on the method taught him and gain confidence in his ability to accomplish results.

In our naval training stations the first thing taught the recruit is personal cleanliness—how to care for his body, how to scrub and wash his clothes, how to mend torn clothing, and in short he is taught self-reliance. He comes under the supervision of the doctor, the dentist and the chaplain. His muscles are toned up through plenty of outdoor work—drills of all descriptions calculated to "set up" the recruit, to change him from an anæmic youth to a robust, bronzed sailor. This is merely physical training.

Just at this moment the time spent at the training

station is of too short duration and in consequence the recruit when he arrives on board a cruising ship is still in the caterpillar stage. Furthermore, due to a woeful shortage of commissioned officers in the navy, the training is in the hands of chief petty officers entirely. This is undoubtedly the weak spot in our training system. Here character should be developed and the chief petty officer, although an excellent schoolmaster in the several drills, is not well equipped for the purpose of character building. He is not far enough removed from the recruit intellectually to be capable of carrying out this difficult task.

At the training station each recruit should be carefully watched and if he should develop the dangerous characteristics of irresponsibility, dishonesty or untrustworthiness, he then should be summarily discharged. Boyish irresponsibility often is not permanent; this can oftentimes be corrected by diligent instruction.

When a man who enlists claims to have a trade, this is noted on his enlistment record and in due time, when he arrives on board a cruising ship, he is given an opportunity to prove his capabilities. If he qualifies he receives the rate.

The enlisted men on board a ship in the navy may be said to be divided into four separate branches according to the character of the work performed.

The first branch is called the " seaman branch." The men of this branch handle the ship and fight the guns. Their specialty is that of the pure sailorman. They all work above deck. The higher ratings in this branch are the boatswain's mates, turret captains, quartermasters, gunner's mates, and sailmaker's mates.

The next branch is the " artificer branch," comprising men who repair the structure of the ship and its hull fittings. The specialties contain the ratings of carpenter's mates, ship fitters, plumbers, painters, blacksmith and coppersmith.

The engineer's branch has control of the boilers and

engines, also the electrical installation of the ship. Among the ratings are machinist's mates, electricians (both general and for radio or "wireless"), oilers, boilermakers, water tenders and firemen.

The special branch contains the non-technical ratings, men whose trade is of the non-combatant type, such as yeomen or clerks, hospital corps men, cooks, messmen, etc.

Each of these branches is essential for the welfare of the ship. All must work efficiently and coördinately for the ship as a whole.

The boatswain's mates are essentially leaders of men on deck. Their specialty is that of the seaman. The quartermasters are both helmsmen and signalmen. They steer the ship, heave the lead and have charge of all the safety appliances dealing with the safe navigation of the ship. The gunner's mates have the care and overhaul of all guns and torpedoes, the supervision of magazines and ordnance stores. The sailmaker's mate sews on canvas of any description, from a sail to an awning or a gun cover. Carpenter's mates work principally in wood, but as wood is fast disappearing in warships their trade is undergoing a transformation. They have the care of the numerous watertight compartments of the ship, the drainage, flushing and fire system and the care and preservation of the hull of the ship in general. Shipfitters work in iron or steel afloat just as they would ashore, and similarly with the other ratings in the artificer branch.

The work of the engineers' branch needs no explanation. Nor the special branch, because the reader is thoroughly familiar with the duties as delineated in the names.

Those men who hold the several ratings described above are all men with specialized knowledge and training. The rank and file, the helpers as they would be called in the industrial world, are plain sailormen above deck and plain coal passers below.

It may be asked, What is the significance of the "mate"? and the answer leads to the description of our

warrant officers: all men of special attainments who have worked themselves up to this important position through their efficiency and reliability in their callings.

Every one is familiar, if he has read "Midshipman Easy," with the "Boatswain," and his silver "pipe" or whistle. He is the leader of the deck force and his helpers are his "mates."

Then the gunner, a practical and hard-fisted warrant officer who has risen to his position through his assiduous labor in keeping in true fighting condition the ordnance weapons with which he has been intrusted. He also is in charge of the powder magazines and shell rooms and guards the personnel from disaster by frequent tests and inspection of the many tons of explosives carried on board for use. The gunner, of course, must have "mates."

The carpenter and the machinist likewise are at the top of their specialties, and their right-hand men are similarly "mates."

On board a modern battleship there are living side by side in close and intimate association one thousand odd men of assorted specialties. In order to weld these many and various activities into a homogeneous whole, there first must be training in each of the specialties themselves and then training in coördinate action with each other.

It is not only necessary that the ship should be navigated and controlled safely, that the guns should be kept in the pink of condition and the guns' crews trained to cut the bull's-eye out of a target, that the engineers run their engines and boilers with intelligence, that the signalmen understand their tasks, that the artificers keep the ship repaired, but all these activities must be brought under an unified control and the ship made to respond to the will of its captain as does the human body to the brain of its owner.

A warship ready to fight, to exert the maximum force permitted by its material construction, must have a trained crew of officers and men. Every warship sent out *to engage* an enemy ship should have a trained crew; and

one trained together in that selfsame ship. Naval reserves, partially trained men, are required for the purposes of (1) supplying shrinkages due to disease and death; (2) to man non-combatant vessels such as supply ships, hospital ships, repair ships, colliers and oil ships; (3) to man patrol vessels; (4) to help form the crews of the ships newly built and commissioned, and (5) as even the least effective warship should be utilized in war, to man the old and obsolete ships of war that have been left, during peace, to slowly deteriorate, out of commission at the many navy yards of the country.

The navy finds itself short of men to man the allowed naval establishment: warships had been added to the navy, increasing in size yearly, but inadequate provision had been made to supply men to man them without unduly injuring the navy at some other point. One further thing had been overlooked: that training men required time; the mere provision of several thousand men did not give *trained* men for at least a year and even longer. It requires from three to four years to build a warship. After commissioning and receiving a crew trained individually, six months will be required to train the ship.

The country should consider available for immediate battle only those warships that have been not less than six months in commission with a full complement of officers and men. This would eliminate our reserve fleet entirely, consisting now of as many battleships as are contained in the active Atlantic Fleet.

This treatment of the subject is believed necessary in order to convince the reader that the navy cannot depend upon reserves or naval militia to man the fleet which upon the outbreak of war should proceed to sea in search of the enemy fleet. The personnel of these ships must be regulars and be as permanent as practical. For this reason the size of our personnel should be a function of the tonnage of our fleet, and increase as our fleet increases.

The recruit himself requires individual training. He must be taught self-reliance, yet be impressed with the spirit of subordination and discipline. He must learn to respect authority and accept responsibility. He must be educated in his own particular technical specialty. After this he must take his place in a great organization wherein there are a thousand other units. These units are formed into groups, and the groups again assembled into larger groups. Over each group a subleader is designated. The intricate organization of a battleship has been evolved through a process of selection, which has required hundreds of years for its development. Its roots stretch back into the sailing days of Nelson, of Paul Jones, of Von Tromp, and even to the row-galleys of Marc Antony. Once the crew has been received on board a battleship, the slow process of evolution must begin. At first all is chaos. Then slowly order arises. The process is slow, necessitating much training and a vast amount of instruction. The ship's complex machinery must be studied. The officers and men must get to know each other, and respect and appreciate each other's responsibilities. Unless mutual trust is engendered throughout the entire ship, coördination cannot be achieved. The ship must be trained to shoot, to manœuvre in company with other ships, to develop the full power of her machinery, to coal and take on stores with efficiency and dispatch, to signal quickly and accurately. Until all these details have been developed to a high state of efficiency, the ship is not a full military unit.

Furthermore, as our navy is growing so rapidly, we must train our officers at the same time as we train our men. Our younger officers have the knowledge but not the "wisdom." Wisdom comes only through training and practice; it cannot be acquired merely by study. Wisdom has been defined by psychologists as knowledge passed from the conscious to the subconscious mind. When we can do the right thing unconsciously, then we are trained.

For instance, imagine an officer at night on the deck of a great dreadnought. He controls absolutely the acts and movements of over thirty thousand tons of steel and in his keeping are the lives of a thousand persons. A sudden emergency arises requiring immediate action. Every second is a lifetime. If that officer is trained, his brain responds to the reflex and he unconsciously and coolly gives the order to avert catastrophe. If he is not trained, his brain becomes suddenly paralyzed. His reflexes have not been created through practice and therefore the appropriate reflex cannot be excited. The consequence is no order or the wrong one is given and the mighty mass of steel goes hurtling to its fate.

There are no safe and certain guides to training except practice. Rules there are, but success can be gained only through the practical application of the rules; reading the rules will point the student in the right direction only; the remainder lies with him.

For an officer, the most important work lies in the handling of men. He must so conduct himself toward his men as to obtain their willing aid. An officer to succeed must get his men to work *with* him. There are many officers in the military services, of acknowledged ability in material, who have failed to be successful owing to a deficiency in military character. They believed the true goal to success lay in driving their men. In consequence they found that many men worked against them; only those with the highest development of loyalty and sense of duty could not be changed; the latter worked on because their loyalty was to a higher authority than the individual temporarily placed over them.

Spirit, the award of effective training, or, in other words, moral power, has and always must be the principal factor in battle. Types and characteristics of ships, the guns and ammunition must perforce play a part, but it is a secondary rôle to the moral forces involved.

Every officer should carefully study himself and prac-

tise the rules in handling men taught by the great leaders.

"Imitation is the sincerest form of flattery." Remember, your men are observing you—perhaps more keenly than you are observing them. Do not be self-conscious, yet remember that your acts may be copied by subordinates. Your bearing, language, and the manner of giving orders should be above criticism.

Refrain from criticism of superiors, otherwise you will find yourself being criticised in like measure and for juster cause.

Be polite, self-contained, and above all be *first*. When you find a subordinate is more capable than yourself, do not be jealous; utilize his ability for the good of the service. Remember, you are yourself only an integral part of a great whole; there is room for a vaster talent than you yourself possess.

Study your men, each individually. Endeavor to bring out the good points of each. Be patient, be unstinting in your praise when it can be honestly given and sparing in your censure. Refrain from fault finding.

Make co-partners with you of your men and encourage their initiative in offering suggestions.

Education of Officers.—The United States Naval Academy at Annapolis, Maryland, is an institution for the education and training of officers for the navy. It occupies about 200 acres of land on the banks of the Severn River. In recent years the Naval Academy has been entirely reconstructed; scarcely a trace of the old Academy of a generation ago remains. All of the buildings are new and built to stand against the ravages of time and are of imposing architecture, by some considered incongruous against the background of old Colonial Annapolis.

The principal buildings include: (1) Bancroft Hall, the commodious quarters of the brigade of student midshipmen, (2) Marine Engineering, (3) Academic, (4) Physics and Chemistry, (5) Administration, (6) Armory, (7) Seamanship, (8) Chapel. Besides, there are quarters

for officers and a building given over for a bachelor officers' mess and guest house.

The student midshipmen are nominated by the President of the United States, Senators and Representatives of the National Legislature. The age limits for entrance are between 16 and 20 years, and candidates are required to satisfactorily pass a rigorous entrance examination before they are given appointments making them full-fledged midshipmen. Upon entrance, an oath of allegiance to the United States is administered whereby the midshipman binds himself to serve in the navy for eight years unless sooner discharged. The course of instruction is of four years' duration. The first year is spent in academic studies, primarily; after that, naval subjects are taught. The entire four years are crowded full of military and naval education and training, including three months each year at sea in warships.

The academic departments are: (1) Discipline department. The officers detailed to this department have charge of the discipline of the midshipmen brigade. They are so far as is practicable selected from officers with the greatest amount of experience; old enough to have the necessary balance; men who have the reputation of having good judgment without an irritable temperament. Their task is a difficult one, for the development of the rudiments of military character in the students is their special aim. They watch over the midshipmen from the day of their entrance until their graduation; they should be to each a guide, philosopher and friend. The value of the finished product to the navy largely depends upon the conscientious work of the discipline officers.

(2) Seamanship Department, or steamanship as it is popularly called, for the reason that sails and old-time seamanship have been replaced by steam and electric machinery. This department instructs in the rudiments of seamanship, handling of ships, the rules of the road at sea, meteorological and other scientific studies required by seamen, strategy and tactics, naval regulations, inter-

national law and other branches of the seaman's profession.

(3) Ordnance and Gunnery Department. The course in ordnance is very complete; the student delves deeply into design, into interior and exterior ballistics and into gun and gun turret construction. The entire modern ordnance of the new navy is studied. In addition gunnery, or the art of using the guns in battle, is carefully and painstakingly taught by officers fresh from its practice in the fleet.

(4) Navigation Department. Astronomy and Navigation are both theoretically and practically taught and reiterated until each graduate is capable of both navigation and piloting.

(5) Marine Engineering Department. The course in marine engineering is becoming most complete. The modern installations are studied after the necessary grounding in principles has been accomplished. The course includes studies of steam boilers, steam engines, reciprocating and turbine, gas engine, Diesel engines, etc. Upon the completion of the course at the Naval Academy and after several years afloat those who desire and are considered sufficiently capable are given a post-graduate course in machinery design either at the Naval Academy or at one of the principal colleges of the country.

(6) Naval Construction Department, now a branch of the Marine Engineering Department, but sufficiently important to form a department by itself. Design of ships, stability, etc., are taught, also the practical methods of construction are studied. For those who will in the future design our warships, a special post-graduate course at an outside technical college is required after graduation at the Naval Academy. The midshipmen who succeed in this branch after receiving their commissions as officers thereafter form a separate and distinct corps.

(7) Mathematics and Mechanics Department. The course is very comprehensive, as it forms the basis of the *technical* branches.

(8) Physics and Chemistry Department. The ground passed over in this department is both comprehensive and thorough. The knowledge here gained is of frequent application in the navy.

(9) Electrical Engineering Department. When it is realized that a battleship machinery is nearly four-fifths electrical, the importance of this department is evident. The studies are comprehensive and a larger number of hours weekly are given to this important subject.

(10) English Department. History is the principal subject. Literature also is taught. Unfortunately the four years' course is so overwhelmingly crowded that the importance of this subject to a naval officer has been neglected.

(11) Modern Language Department. To speak foreign languages and to be familiar with languages sufficient to translate articles on professional subjects are of importance; for those purposes this department endeavors to ground the midshipman in both French and Spanish. To become proficient, practice in the foreign country is necessary, but this has not been done, owing possibly to shortsightedness and shorthandedness, or both.

(12) Naval Hygiene and Physiology Department, started for the purpose of warning the youth in time against the use of alcoholic beverages. It has since been greatly extended in its scope.

The practical work and drills cover a wide field. Warships of different types are kept constantly at the Naval Academy for drill and instruction purposes. The practical drills include: (1) Infantry; (2) light artillery and machine guns; (3) seamanship under sail with boats, steam launches and warships of several types; (4) torpedo overhauling and firing from a modern tube; (5) tactical exercise with steam pinnaces; (6) gunnery drills with guns of six-inch calibre; (7) fire control drill; (8) practical handling of engines and boilers, auxiliary machinery of all kinds; (9) target practice with both

small arms and great guns and training previously with sub-calibre work in preparation.

The Superintendent of the Naval Academy is appointed by the Secretary of the Navy. The officers are selected by the Bureau of Navigation after consultation with the Superintendent.

Upon graduation the midshipman, now a commissioned officer-ensign, finds himself "full to the guards" with knowledge. He oftentimes mistakes this knowledge for wisdom and thereby comes to grief early. He is now prepared to begin his active naval career, but his knowledge of handling men has been learned at the Naval Academy in handling brother midshipmen. Unless the young man is exceptionally well balanced, he is liable when he goes on board ship to make one of the two mistakes: (*a*) He takes a superior and domineering attitude toward the sailormen. (*b*) He becomes too familiar in his official relationship with the sailormen.

The true sailorman dislikes exceedingly either attitude. The midshipman is, to use a slang expression, "up against an entirely new proposition." He has no previous experience to draw upon except his association with brother midshipmen. Here is a critical time in his career, for many eyes are observing him in his daily duty on board ship and their opinions will form the basis of his reputation as a naval officer. Let him therefore study himself and study the writings available on military character and leadership in order that the wisdom of others learned from experience may help him develop in himself the necessary character for an "officer and a gentleman," and above all a true leader of men.

Education of Enlisted Men.—We have seen how the officers are trained for their important work in the navy. Their education is naturally of a more comprehensive nature than is needed for the men. For officers specializations come later in their career, but primarily they must be grounded in every specialty used in the navy.

The navy requires men of many different trades and

of varied knowledge to operate its vessels and to perform all the intricate work required by a naval establishment. In order that young men who enter the navy in the subordinate ratings may become proficient, various trade-schools have been established. These trade-schools are separately described in the following paragraphs.

When a man who enlists claims to have a trade, the recruiting officer is instructed to make an entry to that effect on his service record. This service record follows the man throughout his enlistment. Similarly, when recruits at the training stations demonstrate that they possess a trade, the commanding officers of the training stations are required to make like notation on their records. This is done so that, when the newly-enlisted man arrives on a seagoing vessel, his commanding officer will have a knowledge of any special qualifications he may possess, and will, when practicable, give the man an opportunity to qualify for duty in that trade. The navy desires to encourage men in general service to qualify for trades.

Electrical schools are located at the navy yard at Brooklyn, N. Y., and the navy yard at Mare Island, Cal. The schools are divided into two classes, general and radio. The length of the course for both classes is eight months; and students, either recruits or men from general service, may enter at any time. In order that a recruit may enlist for the electrical branch, he must have a knowledge of either general electricity, or be an operator of the Morse telegraph code, or have sufficient foundation in radio telegraphy to be competent to keep up with the class at the school. Electricians (general) must know the names and uses of the various parts of the dynamo and dynamo engine and must be familiar with the ordinary types of switchboards and methods of wiring. Applicants for both classes must be able to write legibly, must understand elementary arithmetic and must be between the ages of 16 and 25. Applicants for the radio branch must, in addition, pass a creditable examination in spelling and pen-

manship; and the requirements in arithmetic include multiplication, division, simple proportion, percentage and square root. Testimonials as to good character and skill as an operator must be presented by the candidate, either from former employers or from the principal of a trade-school where the candidate has been a student in either telegraphy or radio. He must be able to receive 20 words per minute.

Such recruits are immediately transferred to the electrical school, where the course of instruction comprises machine-shop work. reciprocating steam engines, steam turbine engines, internal combustion engines, magnetism and electricity, dynamos, motors, motor generators, alternating currents, batteries, etc. Members of the radio class are trained in all the duties of a radio operator and are given constant practice in the use of the mechanism employed in radio and in receiving and sending.

The artificer school is located at the navy yard, Norfolk, Va., and is composed of classes for shipwrights, shipfitters, blacksmiths and painters. The shipfitter class also includes the duties of plumber and fitter. The length of the course is three months for each class excepting that for shipfitter, which is six months. Recruits are admitted to the various classes of the artificer school, provided they know some of the trades mentioned well enough to pass the examination, for the course of instruction is not elementary and requires previous knowledge of and aptitude for the trade. Men are permitted, however, to enter the artificer school, if specially recommended by their commanding officers after examination on board ship.

An applicant for the shipfitter class should have had experience as a metal worker; be able to lay out work; know how to chip and calk and drive rivets; understand the various rules for drilling and tapping; have some knowledge of pumping and drainage and be familiar with the required tools and their uses and care. Applicants for the shipwright class should have some practical

experience in carpentry, know the names of the tools used, etc. The instruction is along the same line as for shipfitter, with the addition of cooperage, joiner work, repairing boats, spars, oars, etc., calking seams in wooden decks and cutting threads on bolts with hand dies.

For the blacksmith class, a candidate must have had some experience at the trade. He is taught welding in different ways, " jumping on " pieces, working angle-iron, making shackles, chain, bolts, rivets, mast-bands, eye-bolts, pad-eyes, ironwork for blocks and all fittings likely to be required on board ship which would have to be made with a forge. Blacksmiths are also given special instructions in shackling and unshackling chain.

A candidate for painter must have had some experience as a painter and must know the rules for mixing paint and applying it. He is taught painting of iron and woodwork inside and outside, cabinet and hardwood work and the mixing of all kinds of paint and stain by the different formulæ used in the naval service. He is required to keep a journal in which he gathers much valuable information on ship painting generally.

The yeoman schools are located at Newport, R. I., and San Francisco, Cal. The yeoman branch performs the clerical work of the navy, and a candidate must have had some clerical experience before he can be accepted. He must write a legible hand and be a competent typewriter, the test for which will consist of a letter about 200 words in length with double and single spacing, quotations, headings, paragraphing, etc. Any applicant falling below 70 per cent. in the typewriter examination will not be accepted. A knowledge of stenography will aid the candidate in promotion; but if he is not a stenographer at the time of enlistment, he can join a class in stenography after hours. The yeoman school is divided as follows:

(*a*) Preliminary classes, where instruction is imparted in arithmetic, spelling, composition and such information regarding the naval service as will enable the student to grasp the work which he will take up later. The pre-

liminary classes vary in length from four to six weeks, at the end of which examinations are held to determine the student's aptitude for the other classes.

(*b*) The supply officer department, in which the students are instructed in preparing requisitions, surveys, public bills, official returns, etc.; in the methods of bookkeeping, inventories, mess statements and balance sheets.

(*c*) The executive officer department, where the students learn the duties required in keeping enlisted men's records and the use of the forms employed in keeping track of the arrival and departure of men, ratings and disratings, appointments, discharges, desertions and deaths.

(*d*) Pay officer department, in which a thorough knowledge of arithmetic is required and the student is taught how to make out payrolls, compute pay of officers and men, credit, interest, clothing accounts, allowances, bounties, extra pay, checkages, allotments, deposits, etc.

(*e*) The commanding officer department teaches students the proper care and handling of the typewriter and the forms of official correspondence used in the naval service. They are instructed in the writing of official letters, endorsements, the channels through which they pass, system of filing, proceedings of courts-martial, courts of inquiry, inquests, etc. Stenography is a necessary requirement for a yeoman to a commanding officer.

Each of these four classes is five weeks in length. Each member of the class must serve, in turn, as messman for the members of the class for at least a week. The class hours at Newport are from 8 to 11 A.M., and 1 to 3 P.M. Those entering the stenography class still have ample time in which to keep up with their regular classes. After graduating from the yeoman school and having been advanced in rating to yeoman third class or second class (according to their competency), the students are, as a rule, allowed ten days' leave of absence, with travel time, after which they are sent to the ship or station which needs their service.

Training schools for the hospital corps are located at

the training stations, Newport, R. I., and San Francisco, Cal. Their object is to train new members of the hospital corps by preliminary instruction in their duties in the care of the sick and injured of the navy. The course consists of elementary instruction in the following subjects: Anatomy and physiology; nursing, first-aid and emergency surgery, operating room and surgical technique; hygiene and sanitation, diet, foods, cooking, mess management, pharmacy, materia medica and toxicology, medicines and medicinal agents of the U. S. Naval Supply Table, chemistry; hospital duties, ward management and clerical duties.

After completing the course of instruction at the training school, hospital apprentices are assigned either to a naval hospital for a short period of practical bedside instruction in the care of the sick, or to a cruising ship, as the service requires.

Schools are maintained for musicians, both recruits and men already in the navy, at Norfolk, Va., and San Francisco, Cal. Applicants must be able to read music and play the easy grades on band instruments, either string or brass, and on the piano. The course is eight months long.

Schools for ship's cooks, bakers and commissary stewards are located at San Francisco, Cal., and at Newport, R. I. For the present, men are enlisted as landsmen for ship's cook or for baker; and commissary stewards are advanced from the lower ratings. Applicants must have a knowledge of the trade for which they apply. The course is six months in length in each class.

The machinist school is located at Charleston, S. C., and is open only to re-enlisted men under 30 years of age in the ratings of water-tender, oiler and fireman, first-class. Recruits are not admitted to this school. The length of the course is sixteen months, and the students are given a thorough course in the knowledge of the machinist trade.

The coppersmith school also is located at Charleston

S. C., and is open only to re-enlisted men with some knowledge of the coppersmith trade. The length of the course is six months.

At the Aeronautic Station, Pensacola, Fla., there is a school for the instruction of men in flying. Classes are formed every three months, composed of sixteen enlisted men of the navy, who are selected for the instruction by the commander-in-chief of the U. S. Atlantic Fleet. The course is eighteen months long and is divided into two classes, mechanics and flying. Upon completion of the course, the men are transferred to general service, having been issued a certificate of qualification which entitles them to additional pay of fifty per cent. while detailed to duty involving actual flying; and, in the event of their death from wounds or disease, the result of an aviation accident while engaged in actual flying or in the handling of aircraft, a gratuity is paid the beneficiary amounting to one year's pay at the rate received at the time of the accident; and the pensions allowed by law are doubled.

There is a class at Charleston, S. C., in connection with the machinist school, for instruction in gasoline engines. This class is limited to twenty men and the class is formed every three months. Only men in the ratings of fireman, first and second class, and oilers, are eligible; and preference is given re-enlisted men. This school is not open to recruits.

The Seaman Gunner's school is located at Newport, R. I., and is known as the torpedo class. It is open only to re-enlisted men under 30 years of age. Classes are formed January 1st, May 1st, and September 1st, and continue for eight months.

A special class for machinist's mates is located at the torpedo station for the instruction of re-enlisted men in the duties of machinist's mates, "torpedo."

The school for diving also is located at the torpedo station, Newport, R. I., for instruction in deep-sea diving. The candidates are specially apt pupils of the torpedo class and are not drawn from men on first enlistment.

Recently another school has been added to those already instituted. It is a school for the training of officers and men for the submarine service.

It is now clearly understood that a submarine is a special type of warship and those to operate these vessels require more careful and selected training than the officers and men for surface vessels.

The submarine is not only a surface vessel but it also must navigate under the surface. It has two separate and distinct methods of propulsion. Both of these methods of propulsion are as yet in a state of incomplete development. Special expert knowledge is therefore most important. The safe handling of the vessel submerged requires months of training.

The first submarine training school has been established at the new Submarine Base at New London, Conn. The course includes:

(1) Studies of surface motive power; the Diesel engine, its construction, care and operation.

(2) Study of submerged motive power; the storage battery, electric motors, their construction, care and operation.

(3) Submarine construction — design — submerging features, periscopes, air pumps, drainage and flooding systems—the practical handling of submarines submerged.

(4) Torpedo tubes and torpedoes; design, care, adjustment and overhaul. Practical instruction in torpedo firing.

(5) Diving; each student is instructed in the use of the diving suit and must himself go down in a diving suit not less than three times in water up to fifty feet in depth.

(6) The gyroscopic compass; its design, construction, care and overhaul.

A division of submarines is attached to the base and school for the express use of the students and each officer and man after completion of the six months' course should be capable of fitting in to his position in a submarine boat with full knowledge and some wisdom as to its efficient handling.

Submarine enlisted men are all petty officers, machinist's mates, gunner's mates and electricians. They receive an extra compensation of $5 a month for the extra risk involved and may increase this sum by an additional $15 per month as a maximum, each man receiving $1 for each time the submarine of which he is a part submerges. He is paid for but one dive per day and limited to the above sum per month, provided the daily dives aggregate fifteen as a total.

The Aeronautic Station, Pensacola, Fla., is also used for the training of naval officers to become naval aviators. The officers and enlisted men are here trained together in the same manner as it is proposed to train officers and men to become expert in the handling of submarines. The training is both theoretical and practical. As all students are naval men, the training starts with the complete study of the aeroplane, the principles covering its control, its construction and the design and care of the engines. After having mastered its intricacies, the students are then given introductions in practical flying.

The naval aviator must be as skilful in the control of his machine as is a commander of any one of the types of surface or sub-surface warships.

The naval aeroplane will usually carry a pilot and an observer. The first will have under him the control of the machine itself. This is a most important duty, in fact the most important duty, although it is but the means to the end. The officer or man at the controls must be the one in responsible charge of the aeroplane. The similarity of the helmsman in a surface vessel, where speeds are comparatively small, and where the steering is entirely in one plane, cannot be applied here; in an aeroplane speeds are very high, sometimes over one hundred miles an hour, and the steering is in three directions; here the slightest accident may mean destruction, and a collision in the air will be certain death.

The one in charge of an aeroplane first and foremost must be an expert aviator; he must be in addition an air

navigator, using his compass, the direction and velocity of the wind and his speed to determine the machine's position on the chart. An error of navigation in a surface vessel is not serious, but to an aeroplane, as a naval aviator has expressed it, an error in navigation in the air will as a rule erase the machine and personnel from the navy lists.

The naval aviator must combine all the qualities of a sailorman with his ability to navigate the air.

The observer must also be an aviator in order to be able to render efficient service. An officer or man who is not "at home" in the air is useless as an observer. One unaccustomed must apply his mind to becoming accustomed to his novel and dangerous position. As for his duties as an observer, he must be above all a naval man. He must be able to distinguish types of warships and their nationality by a sweep of the eye. He must thoroughly understand both strategy and tactics, in order to make an accurate estimate of what work the vessels he observes are performing.

Aeroplane tactics are in the formulative stage, but such tactics will be evolved in the course of development, making it all the more imperative that the one having the controls shall be the responsible commander of the machine.

Imagine the helplessness of a naval officer in command of an aeroplane who cannot control the machine himself but must rely upon the ability of a man of less intelligence performing this duty for him. What would we say of a submarine commander who was so incapable?

Inasmuch as the naval aviator must be both operator and observer, all must be trained both as naval officers and as aviators. To bring into the navy a number of men with only the single qualification of aviator may be correct in case the machines in all cases are to have double controls. The commanding officer then may feel the controls himself, merely trusting them to the aviator or chauffeur in cases of long sustained flights and where questions

of tactics and close manœuvring do not exist. These men usually will not have had previous training to fit them to become naval officers and their real usefulness to the navy can be only transient.

In time of war we must expand our aviation corps and to this end men with no naval experience, but with flying training, will be mustered into service. These flyers will be merely chauffeurs and will accompany naval aviators in the same way as a chauffeur accompanies the owner of a motor car who runs his own car, to be on hand to help in the adjustment of the engine and to take the controls at such times as the commander of the aeroplane desires to be relieved temporarily of the continued strain.

CHAPTER VIII

HONORS AND DISTINCTIONS

From the earliest times the salute as a form of military courtesy has been observed. A well-disciplined ship or fleet is indicated by its strict observance of the forms of military courtesy.

Personal Salutes.—A junior always must salute his senior in rank. The salute is reciprocal, and an officer saluted by a junior or an enlisted man should be quickly called to account for his failure to respond.

The omission of a salute by an enlisted man frequently occurs through ignorance as to when the salute is required. The best rule is when in doubt salute. Officers should always insist upon being saluted, especially from recruits.

The Hand Salute.—Raise the right hand smartly until the tip of the forefinger touches the lower part of the head-dress above the right eye, thumb extended from joined fingers, palm to the left, forearm inclined at about 45 degrees, hand and wrist straight. Turn the head and eyes toward the person saluted. Render the salute at six paces before passing or being passed by the person to be saluted.

The admiral and captain should be saluted upon every occasion of meeting, passing near or being addressed by them.

On board ship salute all officers junior to the captain on their first daily meeting or passing near and whenever addressed by them or addressing them. At other times stand at attention, facing the officer, until he has passed. Men engaged in work salute only when addressed. Officers on official inspections must be saluted.

Men seated at work or at mess do not rise to salute a passing officer unless called to attention or when it is necessary to clear a free passage.

Boat Etiquette.—A junior enters a boat first and gets out last. The stern sheets of a boat are reserved for the officers or men of most rank. Officers when in a boat do not rise to salute. The coxswain of a boat without awnings spread rises to salute an officer in a passing boat.

Men in boats at the boom all rise and salute unless awnings are spread, when they salute seated.

The signal for general "attention" on board ship is sounded on the bugle. All officers and men stand and face the person for whom the signal is sounded. Those not in sight must keep silence but need not rise. The signal for "carry on" is sounded on the bugle.

"Gangway" is a term used in the navy for the purpose of clearing a gangway through a crowded part of the ship. Men must rise if seated, all stand at attention and make room for the officer or officers passing.

Boat Salutes.—The table on page 81 shows how salutes are to be made and returned in boats of the navy.

Notes on Chart.—Uniform is that designated to be worn on the occasion of the visit. S. F. D. indicates special full-dress uniform.

Certain officers are saluted with guns both on arrival and departure.

Ruffles are given on the bugle.

The full guard means the entire marine or sailor guard and the officers attached. The guard of the day is a sergeant's guard of sixteen men.

S. boys indicate the side honors to be given. The side boys are placed in two lines at the gangway. The distinguished visitor being received passes through the lines of side boys.

In case of our naval or military officers no flag is flown at the fore truck.

When the President of the United States visits a ship of the navy, all officers of the vessel shall assemble in special full-dress on the side of the quarter-deck on which he enters; he shall be received at the gangway by the flag officer and commanding officer, accompanied by such other

officers as may be designated; the yards or rails shall be manned; the full guard paraded; and such of the crew as are not otherwise employed shall be formed in order

Rank or rate of the senior in the saluting boat	Rank of the senior officer in the boat to be saluted			
	Flag or general officer (with flag flying)	Commanding officer above rank of lieutenant (with pennant flying)	Other commissioned officer	Midshipmen or warrant officers
Flag or general officer	Junior salutes with hand			
Commanding officer above rank of lieutenant (with flag flying)	Stop engine, lay on oars, and salute with hand	Junior salutes with hand		
Other naval officers below flag rank and above rank of lieutenant and marine officer of corresponding rank	Stops engine, lays on oars, and salutes with hand	When meeting a senior commanding officer, or immediate commanding officer, stops engine, lays on oars, and salutes with hand	Junior salutes with hand	
Other commissioned officers	Stops engine, tosses or trails oars and salutes with hand	Stops engine, lays on oars and salutes with hand	Junior salutes with hand	
Midshipman or warrant officers	Stops engine, tosses or trails oars, and salutes with hand	Stops engine, lays on oars, and salutes with hand	Salutes with hand	Junior salutes with hand
Officer and coxswain in loaded boat or boat under sail	Salutes with hand	Salutes with hand	Junior salutes with hand	Junior salutes with hand
Coxswain.........	Stops engine, tosses or trails oars, stands and salutes with hand	Stops engine, lays on oars, stands and salutes with hand	Stands and salutes with hand	Salutes with hand

forward of the guard. When the President reaches the deck, officers and men shall salute; the guard present arms; the drum give four ruffles and the bugle sound four

flourishes; the ruffles and flourishes shall be followed by the national air by the band. The President's flag shall be displayed at the main at the moment he reaches the deck and kept flying as long as he is on board. A national salute shall be fired as soon as practicable after the President shall have been received. The same ceremonies shall be observed when the President leaves the ship, the salute being fired when the boat shall be sufficiently clear. Should no band be present to play the national air, the bugle shall sound "To the color." The President's flag shall be hauled down with the last gun of the salute.—Naval Regulations, 1101 (1).

All other ships of the navy present at the time of the official reception or departure of the President shall, unless otherwise directed by the senior naval officer present, man yards or rail and fire national salutes at the same time as the ship visited.—Naval Regulations, 1101 (2).

A ship of the navy flying the flag of the President shall be regarded as the ship of the senior officer present, and her motions shall be followed accordingly.—Naval Regulations, 1101 (3).

Whenever the President is embarked in a ship flying his flag, all ships of the navy, on meeting her at sea or elsewhere, and all naval batteries when she is passing, shall fire a national salute.—Naval Regulations, 1101 (4).

When the President, embarked on board a ship with his flag flying, passes close aboard a ship of war, the yards or rail shall be manned unless instructions to the contrary have been received from the senior officer present, the full guard shall be paraded, the band playing a strain of the national air, officers and men above decks at attention and salute. The same ceremonies shall be observed by a ship when passing the President's flag flying aboard another ship.—Naval Regulations, 1101 (5).

When the President, embarked in a boat with his flag flying, passes close aboard a ship of the navy, the full guard of the latter shall be paraded in a conspicuous position, four ruffles given on the drum and four flourishes

s	Flag
rail	President's, at main, during visit.
and	National, at main, during visit.
oys ..	National, at main, during salute.
oys ..	National, at main, during salute in foreign countries.
oys...	National, at fore, during salute.
oys...	National, at fore, during salute.
ys...	Secretary's, at main, during visit.
ys...	Assistant Secretary's, at main, during visit.
ys...	National, at fore, during salute.
ys...	National, at fore, during salute.
ys...	National, at fore, during salute.
ys...	National, at fore, during salute.
ys...	National, at fore, during salute.
ys...	National, at fore, during salute.
ys...	National, at fore, during salute.
ys...	National, at fore, during salute.
ys...	National, at fore, during salute.
ys...	National, at fore, during salute.
ys...	National, at fore, during salute.
ys...	
ys...	National, at fore, during salute.
ys...	National, at fore, during salute.
ys..	In case of foreign officers, national, during salute, at fore
ys..	
ys..	
ys..	
ys...	
ys...	
ys...	
ys...	
ys...	

flourishes; the ruffles and flourishes shall be followed by the national air by the band. The President's flag shall be displayed at the main at the moment he reaches the deck and kept flying as long as he is on board. A national salute shall be fired as soon as practicable after the President shall have been received. The same ceremonies shall be observed when the President leaves the ship, the salute being fired when the boat shall be sufficiently clear. Should no band be present to play the national air, the bugle shall sound "To the color." The President's flag shall be hauled down with the last gun of the salute.—Naval Regulations, 1101 (1).

All other ships of the navy present at the time of the official reception or departure of the President shall, unless otherwise directed by the senior naval officer present, man yards or rail and fire national salutes at the same time as the ship visited.—Naval Regulations, 1101 (2).

A ship of the navy flying the flag of the President shall be regarded as the ship of the senior officer present, and her motions shall be followed accordingly.—Naval Regulations, 1101 (3).

Whenever the President is embarked in a ship flying his flag, all ships of the navy, on meeting her at sea or elsewhere, and all naval batteries when she is passing, shall fire a national salute.—Naval Regulations, 1101 (4).

When the President, embarked on board a ship with his flag flying, passes close aboard a ship of war, the yards or rail shall be manned unless instructions to the contrary have been received from the senior officer present, the full guard shall be paraded, the band playing a strain of the national air, officers and men above decks at attention and salute. The same ceremonies shall be observed by a ship when passing the President's flag flying aboard another ship.—Naval Regulations, 1101 (5).

When the President, embarked in a boat with his flag flying, passes close aboard a ship of the navy, the full guard of the latter shall be paraded in a conspicuous position, four ruffles given on the drum and four flourishes

	Flag
ail	President's, at main, during visit.
nd	National, at main, during visit.
s ..	National, at main, during salute.
s ..	National, at main, during salute in foreign countries.
s...	National, at fore, during salute.
s...	National, at fore, during salute.
s...	Secretary's, at main, during visit.
s...	Assistant Secretary's, at main, during visit.
s...	National, at fore, during salute.
s...	National, at fore, during salute.
s...	National, at fore, during salute.
s...	National, at fore, during salute.
s...	National, at fore, during salute.
s...	National, at fore, during salute.
s...	National, at fore, during salute.
s...	National, at fore, during salute.
s...	National, at fore, during salute.
s...	National, at fore, during salute.
s...	National, at fore, during salute.
s...	
s...	National, at fore, during salute.
s...	National, at fore, during salute.
s...	In case of foreign officers, national, during salute, at fore
s..	
...	
s..	
s...	
s...	
s...	
s...	
s...	

he shall receive the same honors as prescribed for the President of the United States, except that there shall be but one salute of nineteen guns, which shall be fired upon his arrival instead of on departure.—Naval Regulations, 1103 (2).

When the President of a foreign republic or a foreign sovereign visits a ship of the navy the same honors as those prescribed for the President of the United States shall be extended, except that the national ensign of the country represented shall be displayed at the main during the entire visit and the national air of that country played by the band.—Naval Regulations, 1104 (1).

When the President of a foreign republic or a foreign sovereign visits a naval station officially he shall receive the same honors as prescribed for the President of the United States, the national air of his country being played by the band.—Naval Regulations, 1104 (2).

When any member of a royal family visits a ship of the navy the honors prescribed for a President of a foreign republic or a foreign sovereign shall be extended, except that the national flag shall be displayed only during the salute.—Naval Regulations, 1105 (1).

When any member of a royal family visits a naval station officially he shall receive the same honors as prescribed for a President of a foreign republic or a foreign sovereign visiting a naval station, except that the national air of his country shall be played by the band.—Naval Regulations, 1105 (2).

Whenever a ship of the navy falls in with a friendly foreign ship of war flying the standard or flag of a President of a republic, sovereign or member of a royal family, or passes near such standard or flag, if flying elsewhere than from a ship of war, a national salute shall be fired and the flag of the nation of the president, sovereign, or prince displayed at the main during the salute.—Naval Regulations, 1106.

When the Secretary of the Navy visits officially a ship of the navy, all officers of the vessel shall assemble in

special full-dress on the side of the quarter-deck on which he enters; he shall be received at the gangway by the flag officer and the commanding officer, accompanied by such other officers as may be designated; the full guard shall be paraded, and the crew formed in order forward of them. When the Secretary reaches the deck, officers and men shall salute, the guard present arms, the drum give four ruffles and the bugle sound four flourishes; the ruffles and flourishes shall be followed by a march by the band, and the Secretary's flag shall be displayed at the main while he is on board. A salute of nineteen guns shall be fired as soon as practicable after he is received on board. The same ceremonies shall be observed when the Secretary of the Navy officially leaves the ship, the salute being fired when the boat shall be sufficiently clear; the Secretary's flag hauled down with the last gun of the salute.—Naval Regulations, 1111 (1).

When a ship of the navy falls in with a vessel flying the flag of the Secretary of the Navy, his flag shall be saluted with nineteen guns. If two or more ships in company fall in with a vessel flying such flag, only the senior of the ships in company shall fire a salute.—Naval Regulations, 1111 (2).

When the Secretary of the Navy, embarked in a boat with his flag flying, passes close aboard a ship of the navy, the full guard of the latter shall be paraded in a conspicuous position, four ruffles given on the drum and four flourishes sounded on the bugle, a march shall be played by the band, and officers and men shall salute. The same ceremonies shall be observed by a ship passing the Secretary's flag flying in a boat.—Naval Regulations, 1111 (4).

When the Secretary of the Navy is regularly embarked on board a ship of the navy, but is absent therefrom at night with the intention of returning within twenty-four hours, his absence shall be indicated by six white lights displayed at the peak, one above the other.—Naval Regulations, 1111 (5).

When the Secretary of the Navy visits a naval station,

officially, the honors prescribed for visiting a ship shall be rendered, as far as practicable, the full guard being paraded and the Secretary received by the Commandant and other officers at such place or places as may be suitable.—Naval Regulations, 1111 (6).

When the Secretary of the Navy, embarked on board a ship of the navy with his flag flying, passes close aboard a ship of the navy, both ships shall exchange salutes by the full guard of each presenting arms, the band playing a strain of the national air, officers and men above decks at attention and salute at the end of the music.—Naval Regulations, 1111 (3).

When a flag officer goes on board his flagship to assume command the officers of the vessel shall assemble in dress uniform on the side of the quarter-deck on which he enters; he shall be received at the gangway by the commanding officer and such other officers as the latter may designate; the guard shall be paraded and the crew at quarters ready for inspection. When the flag officer reaches the deck, officers and men shall salute; the guard present arms; ruffles and flourishes be given; the band play a march, and the flag officer's flag be hoisted and saluted with the number of guns to which he is entitled.—Naval Regulations, 1127 (1).

If a flag officer assumes command in the presence of another flag officer his senior, the flag of the former shall not be saluted, but he shall salute the flag of his senior, which salute shall be returned according to the scale prescribed. If a flag officer assumes command in the presence of one or more flag officers, his juniors, the salute provided for shall be fired, and in addition he shall be saluted by the flag officer next in rank and by him only. This salute shall be returned according to the scale prescribed.—Naval Regulations, 1127 (2).

The following table gives honors to be rendered under the circumstances stated in left column:

OCCASIONS	HONORS
(1) Passing or being passed by a foreign man-of-war United States man-of-war, with or without personal flag flying, whether member of fleet, squadron, or division, or not, if she has been or is on detached duty.	Guard of the day and band; attention by bugle; national air; hand salute at the end of national air.
(2) Passing or being passed by vessel of own formation or a United States vessel under third-rate or auxiliary flying a pennant.	Attention on bugle; hand salute. In outside tactical evolutions, none.
(3) Flag officer, with flag flying, comes on board.	Full guard and band; attention bugle; flourishes; march; tend side. Hand salute at command "present arms," and remain at salute until end of flourishes.
(4) Flag officer, in a boat, passes close aboard with flag flying.	Guard of the day and band; attention by bugle; flourishes; march. Hand salute as in (3).
(5) Flag officer, in uniform, with no flag flying, comes on board.	Attention on quarter-deck without bugle; tend side. Hand salute while piping side as flag officer comes on board.
(6) Flag officer, in a boat, passes close aboard without flag flying, whether in uniform or not.	No general honors; boat keepers, sentries, and others salute.
(7) Commanding officer, of or above rank of lieutenant commander, passes close aboard with pennant flying.	Attention by bugle; officers and petty officers on watch, boat keepers and sentries salute, others stand at attention.
(8) Commanding officer, of or above rank of lieutenant commander, with pennant flying, comes on board.	Guard of the day; attention by bugle; tend side. Hand salute at command "present arms," and remain at salute until command "order arms."
(9) Commanding officer, of or above rank of lieutenant commander, comes on board, no pennant flying.	Attention on quarter-deck without bugle; tend side. Hand salute while piping side as officer comes aboard.
(10) All officers, not specified, coming on board in uniform.	Attention near gangway without bugle; tend side. Hand salute as in (9).
(11) All officers not specified above, passing close aboard, whether in uniform or not, or when coming on board in civilian clothes.	No general honors; boat keepers, sentries and others salute.

The officer of the deck shall attend at the gangway on the arrival or departure of any commissioned officer or distinguished visitor.—Naval Regulations, 1165.

Side boys shall attend at the side when side is piped, as follows, except as noted:

(*a*) For officials saluted with fifteen or more guns, eight.

(*b*) For officials saluted with eleven or thirteen guns, six.

(*c*) For other officers of and above the rank of commander, and for officials entitled to corresponding honors, four.

(*d*) For other commissioned officers of the navy or Marine Corps and officials entitled to corresponding honors, two.—Naval Regulations, 1167.

The starboard gangway shall be used by all commissioned officers and their visitors; the port gangway shall be used by all other persons. If the construction of the ship or other circumstances make a change in this rule expedient, the change may be made at the discretion of the commanding officer.—Naval Regulations, 1170.

All officers and men, whenever reaching the quarter-deck, either from a boat, from a gangway, from the shore, or from another part of the ship, shall salute the national ensign. In making this salute, which shall be entirely distinct from the salute to the officer of the deck, the person making it shall stop at the top of the gangway or upon arriving upon the quarter-deck, face the colors, and render the salute, after which the officer of the deck shall be saluted. In leaving the quarter-deck, the same salutes shall be rendered in inverse order. The officer of the deck shall return both salutes in each case, and shall require that they be properly made.—Naval Regulations, 1171 (1).

The commanding officer shall clearly define the limits of the quarter-deck; it shall embrace so much of the main or other appropriate deck as may be necessary for the proper conduct of official and ceremonial functions. When the quarter-deck so designated is forward and at a considerable distance from the colors, the salute to the colors prescribed in the preceding paragraph will not be rendered

by officers and men except when leaving or coming aboard the ship.—Naval Regulations, 1171 (2).

The salute to the national colors to be made by officers and enlisted men with no arms in hand shall be the " hand salute," the head-dress not to be removed.—Naval Regulations, 1171 (3).

Whenever " The Star Spangled Banner " is played on board a vessel of the navy, at a naval station, or at any place where persons belonging to the naval service are present in their official capacity, or present unofficially but in uniform, all officers and enlisted men present shall stand at attention, facing toward the colors, or, if no colors, the music, retaining that position until the last note of the air, then, if covered, salute. The same respect will be observed toward the national air of any other country when it is played as a compliment to official representatives of that country. When played by a naval band under the circumstances contemplated by this paragraph, " The Star Spangled Banner " shall be played through without repetition of any part not required to be repeated to make the air complete.—Naval Regulations, 1172.

Except when there is a countersign, the answering hail from a boat, in reply to a ship's hail, shall be varied according to the senior officer or official who may be in the boat, as follows:

President of the United States......	" United States."
Secretary or Assistant Secretary of the Navy	" Navy."
Flag officer in chief command.......	" Fleet."
Chief of Staff (when not in command of a ship)..................	" Staff."
Division Commander	"——— Division." (Giving number of his division.)
Flotilla Commander	" Flotilla."
Commanding Officer	The name of the ship under his command.
Other commissioned officers	" Aye, aye."
Other officers	" No, no."
Enlisted men and marines...........	" Hello."
Boats not intending to go alongside regardless of rank of passengers..	" Passing."

Steam launches approaching a ship when a flag or pennant is not displayed in the bow may sound short blasts on the steam whistle at night or during the day when the curtains are so drawn that the rank of passengers cannot be distinguished, as follows:

President of the United States	Eight.
Secretary of the Navy	Seven.
Assistant Secretary of the Navy	Five.
Admiral of the Navy	Seven.
Admiral	Six.
Vice Admiral	Five.
Other flag officers	Four.
Commanding Officer, Chief of Staff, or torpedo flotilla commander	Three.
Other commissioned officers	Two.
All others	One.

—N. R., 1176.

Honors and Salutes to Foreign Governments and Officials.—When a ship of the navy enters a port of any foreign nation the government of which is recognized by the United States, where there is a fort or battery displaying the national flag, or where a commissioned ship of war of that nation is lying, she shall fire a salute of 21 guns unless her commanding officer has reasons to believe that the salute cannot be returned; and in this case he shall immediately take steps to ascertain the local regulations or customs. This salute shall be the first fired after entering the port. The ensign of the nation saluted shall be displayed at the main during the salute. In case two or more ships enter in company, only the senior shall salute.—Naval Regulations, 1191.

When a ship of the navy falls in at sea with a friendly foreign ship of war flying the flag or pennant of a flag officer or commodore, she shall exchange salutes with such ship of war in the same manner as when meeting similar ships of the United States, and the salute will be returned gun for gun.

The national ensign of the country of the officer saluted shall be displayed at the fore during such salute.

In port, if several flag officers are to be saluted, the

salutes shall be fired in the order of their grade; if of the same grade, priority shall be given, first, to the nationality of the port, and, second, to the length of services of the flag officers in their respective commands. As between flag officers of the same grade, the last comer will salute first. These salutes shall be fired as soon as possible after the usual boarding visits have been made, if not fired before. The national ensign of the country of the officer saluted shall be displayed at the fore during such salute.—Naval Regulations, 1192.

No salute shall be fired in honor of any nation or of any official of any nation not formally recognized by the Government of the United States.—Naval Regulations, 1194.

Officers and men of the navy shall extend to foreign officials, when passing near ships of the navy with the insignia of their rank flying or when met ashore or afloat, the personal salutes and other marks of respect due to similar officials of the United States.—Naval Regulations, 1195.

No ship of the navy shall lower her sails or dip her ensign unless in return for such compliments.

Of the colors carried by a naval force on shore, only the battalion or regimental colors shall be dipped in rendering or acknowledging a salute; the national colors shall not be dipped, except when passing in review before the President or as a compliment to the sovereign or ruler or a member of the royal family of another country.—Naval Regulations, 1196.

National airs of foreign states shall be played by the band as a compliment as follows:

(*a*) In the morning, after colors, the national air of the port, followed by the national airs of the ship of war present, in the order of rank.

(*b*) When passing or being passed by a foreign ship of war close aboard, at which time officers and men on deck and in sight shall salute and sentries present arms.—Naval Regulations, 1197.

A national salute shall consist of twenty-one guns. The interval between guns in all salutes shall be five seconds.—Naval Regulations, 1202.

In the official presence of the President of the United States, or of the president or sovereign of any other nation, no gun salute shall be fired by vessels of the navy to any personage of lesser degree.

No salute shall be fired in the presence of a senior without his permission, except it be one in honor of such senior.

Whenever a salute is fired, following the motions of the flagship or ship of the senior officer present, each ship shall begin its salute with the first gun from the flag or senior ship.

During the firing of a salute all officers and men on deck shall stand at attention and face toward the ship or person saluted.—Naval Regulations, 1203.

No salute shall be fired between sunset and sunrise. As a general rule, salutes shall be fired between 8 A.M. and sunset. Salutes shall not be fired on Sunday, unless required by international courtesy. The national ensign shall always be displayed during a salute.

In the case of a salute at 8 A.M., the first gun shall be fired at the last note of "The Star Spangled Banner."—Naval Regulations, 1204.

Ensigns, Flags and Pennants.—The distinctive mark of a ship of the navy in commission, other than the national ensign, is a flag or pennant at a masthead.

The distinctive mark of the senior on board shall be displayed day and night, and shall be carried at the main, except the flag of a rear admiral and pennant of a senior officer present, which shall be carried at the after-mast and starboard after-yard arm, respectively.—Naval Regulations, 1236.

When the personal flag of the President of the United States, of the Secretary of the Navy, of the Assistant Secretary of the Navy, or of the Admiral of the Navy is flying aboard any ship of the navy, no other personal

flag or pennant shall be displayed aboard such ship. Should two or more of the above-named officials visit a ship at the same time, the flag of the senior only shall be displayed.—Naval Regulations, 1237.

The national ensign on board a ship of the navy at anchor shall be hoisted at 8 A.M. and kept flying until sunset. Whenever a ship comes to anchor or gets under way, if there is sufficient light for the ensign to be seen, it shall be hoisted, although earlier or later than the time specified. Unless there are good reasons to the contrary, the ensign shall be displayed when falling in with other ships of war or when near the land, and especially when passing or approaching forts, lighthouses, or towns.—Naval Regulations, 1238.

When at anchor the union jack shall be flown from the jack staff from morning colors to evening colors.

The jack hoisted at the fore is a signal for a pilot. A gun may be fired to call attention to it.

The jack hoisted at the mizzen or at a yard-arm denotes that general court-martial or court of inquiry is in session. It is to be hoisted (and, if in port, a gun fired) when the court meets and to be hauled down when the court adjourns.—Naval Regulations, 1239.

The boat ensign shall always be displayed from boats between 8 A.M. and sunset, when away from the ship, if in a foreign port. When a ship is dressed the ensigns of boats which are absent from the ship or at the booms shall be displayed. An ensign shall always be displayed in a home port when boarding foreign vessels, and at such other times as may be prescribed by the commanding officer.—Naval Regulations, 1240.

When two or more flag officers of the same grade meet the senior only shall fly the blue flag, and all others the red.—Naval Regulations, 1241.

When two or more ships of the navy are together, with no distinctive flag of a flag officer or division commander flying, the senior officer's pennant shall be displayed at the starboard after yard-arm of the senior ship, in addition *to the narrow* pennant at the main.—N. R., 1242.

The following rules, in which the maritime powers generally have concurred, shall be observed by all officers of the navy in regard to the interchange of visits with officers of friendly foreign ships of war in all ports. Their observance by foreign officers may be expected:

(*a*) The senior officer in port, whatever may be his rank, shall, upon the arrival of a foreign ship of war, send an officer to such ship to offer the customary courtesies. In case two or more ships of the same nation arrive in company, then the visit shall be made to the senior ship only.

(*b*) When such a visit is made to a ship of the navy an officer shall be sent to return it at once.

(*c*) Within twenty-four hours of arrival, the flag or other officer in chief command of the arriving ship or ships shall visit the flag or other officer in chief command of the foreign ship or ships present in port, if the latter be his equal or superior in grade. Such a visit made to a ship of the navy shall be returned within twenty-four hours.

(*d*) In the case of officers of different grades the junior shall pay the first visit, the same limits of time being observed as to the visit and its return.

(*e*) All flag officers shall return visits of officers of the grade of captain and of those of superior grades. They shall send their chief of staff to return the calls of commanders or other junior commanding officers.

(*f*) Captains and commanding officers of junior grades shall return all visits made to them by commanding officers, whatever their grade.

(*g*) In the case of two or more ships arriving in port or lying in port when another ship arrives, and after the interchange of visits between the senior officers shall have taken place, the captains or other officers in command of the several ships of war arriving shall call upon the flag officer, the captains, and other officers in command of the ships of war in port, who will return the visits with the exceptions mentioned in paragraph (*e*) above.—Naval Regulations, 1267.

PART II

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CHAPTER IX

SEA POWER

"SEA POWER" is a term for which the world must give credit to the late Admiral A. T. Mahan. He was the first historian to elucidate it. We now understand it to mean "all the elements of the naval strength of the state referred to."

"Notwithstanding the much greater frequency of land wars, the course of history has been profoundly changed more often by contests on the water."

The fate of North America was determined by sea power. If it had not been for British sea power, North America would not have been a British Colony.

It was the deciding factor in the war between Rome and Carthage. It has had a dominating effect upon history.

The Phœnician cities and their great colony Carthage, by the enterprise of their navigators, created a great sea power which gave them for a time practically undisputed command of the Mediterranean west of Sicily. The control of these waters became the object of memorable struggles. Upon the outcome of these contests depended the empire of the world.

It is almost a principle or law of the civilization of the world that "a consolidation and expansion, from within outwards, of great continental states have had serious consequences for mankind when they were accomplished by the acquisition of a coast-line and the absorption of a maritime population." This law is as true to-day as it was in the halcyon days of Athens, Carthage and Rome. The great continental empires had a traditional horror of the water, but this disappeared after the acquisition of a coast-line and the absorption of its seafaring inhabitants.

All historians have dwelt at some length upon the

efforts of the land powers, Assyria, Egypt, Babylon and Persia in turn, to get possession of the maritime resources of Phœnicia. Admiral Cyprian Bridge, of the British Navy, sounds a note of warning and prophecy to his own countrymen when he says: " Our own immediate posterity will perhaps have to reckon with the results of similar efforts in our own day. It is this which gives a living interest to even the very ancient history of sea power, and makes the study of it of great practical importance to us now." What the Admiral had in mind was the acquisition by the German land power of a coast-line and the absorption of its seafaring population.

Persia enlisted the naval power of Phœnicia and, thus aided, invaded Greece. When the master of a great army is likewise the master of a great navy, world dominion is the logical result.

The Greeks under the compelling eloquence of Themistocles looked to their navy to save them from the yoke of the Persian Monarch Xerxes. True his fleet was more numerous than the Greek allies, but history tells us over and over again that " the race is not always to the swift or the battle to the strong." Naval efficiency does not depend upon numerical superiority alone. The sea battle at Salamis was a Greek victory. Greece thus was saved from oppression by the Persians. The Persian sea power was artificial, a grafted limb upon the Oriental Empire, while to Greece sea power was a natural development of its national vitality.

In the Peloponnesian war between Athens and the remaining Greek states, the sea power of Athens was defeated because its administration was in the hands of incompetent men at home. It met its downfall at Syracuse, although for some time afterwards it waged a naval war on a purely defensive scale.

Rome and Carthage long contested the control of the Western Mediterranean. Carthage aided by the merchant marine and sailors of Phœnicia used her sea power to build up a great trade along the Mediterranean littoral.

It is said by some historians that lust of wealth rather than lust of dominion prompted Rome to a trial of strength with Carthage.

When Rome decided to make the most of her natural resources the maritime predominance of Carthage was doomed. Carthaginian sea power being based to a considerable extent upon mercenaries, it could not long withstand serious assaults by the great Roman military system. Rome built up a great sea power. In the first Punic War, Rome was partially successful, but in the second, the Carthaginian sea power was virtually destroyed and that of Rome predominated. The great land power had become the great sea power. World dominion was the result.

The Mohammedan conquest of Northern Africa from Egypt westward to the Pillars of Hercules was helped in no small measure by Saracen sea power.

"With the conquest of Syria and Egypt a long stretch of seaboard had come into the Saracenic power and the creation and maintenance of the navy for the protection of the maritime ports as well as for meeting the enemy became a matter of vital importance. Great attention was paid to the manning and equipment of the fleet."

The neglect of sea power by those that can be reached by the sea has always proved disastrous. The reason is evident. The sea is a natural military road leading direct to the shores of those countries whose borders touch the ocean. It is a road that cannot be destroyed. The one way to block it against an enemy is the acquisition of sea power sufficient to make an attempted invasion from over sea so hazardous as to be an unprofitable venture for even the strongest sea power.

Even when not neglected, if the sea power is not a natural growth, in the event of being wielded against a sea power that is of natural growth, the artificial creation will most frequently meet defeat.

History has proved this fact by many examples. Artificial sea powers were those of Persia, Carthage and the Saracens. Persian sea power met its downfall at the

hands of Greek sea power, Carthage fell before the onslaughts of Roman sea power, while the Saracens were worsted by the sea power of the Crusaders.

The commerce of the Mediterranean became the property of the Italian Republics through their great sea power. Venice eventually gained the supremacy over the sea powers of Genoa and Pisa. The rise of the Turkish sea power threatened that of Venice and of Christendom. The Turks exemplified the principle once more that a military state expanding to the sea and absorbing maritime populations becomes a serious menace to its neighbors. Turkish sea power, however, was artificial. It was given its death blow at Lepanto, by the combined sea powers of Venice and Spain.

The sea power of Spain now became the greatest in the world. The fusion of Spain and Portugal gave to the combined sea power a vast fleet, a larger maritime population and a sufficient number of ports as bases of operations.

Spanish sea power received a mortal wound in the defeat of the Armada at Gravelines by the rising British sea power.

England appeared to understand, even as far back as the Middle Ages, the importance of sea power. She had always claimed the sovereignty of the "Narrow Seas."

The battles of Crecy, Poitiers and Agincourt were fought by the English on French soil. Why? because of the existence of British sea power, a naval power greater than that of France. Sea power has been England's sure defense against invasion even as far back as the Thirteenth Century. In 1217 reinforcements attempted to cross the Channel between Calais and Dover, escorted by a French fleet, to go to the assistance of the French army and the rebel English barons who had been defeated at Lincoln.

The Admiral of the British fleet upon hearing of the enemy's movements declared: "If these people land, England is lost, let us therefore boldly meet them." The British put to sea and destroyed the expedition.

In the Sixteenth Century the maritime importance of England was increased and maintained by private enterprise, yet these enterprises were "underwritten" by the whole sea power of England.

In the acquisition of naval power by England we see the principle of Mahan fulfilled: "Navies depend upon maritime commerce as the cause and justification of their existence." In the sixteenth and seventeenth centuries England relied upon her sea power to support distant commerce. It became a powerful instrument for carrying out a definite maritime policy. This was the beginning of a standing navy. Her ships were officered and manned by those who could handle their ships and supervise the working of the battery. Landsmen ceased to be appointed to important naval positions, only those fitted to exercise military command afloat were considered.

England's commercial aspirations soon conflicted with the established commercial holdings of first Spain and afterwards Holland. The expansion of English commerce therefore caused collisions with both countries and the natural result was war until one sea power, that of England, gained the ascendency.

The marvellously rapid rise of the Dutch sea power has no parallel in history. The two wars fought between England and Holland were for what was primarily a maritime object. England wanted a large share of the world trade built up by the Dutch and relied upon her sea power to obtain the object.

Free and open trade competition between states has seldom if ever been possible to maintain. The road to both individual and national prosperity lies in securing a monopoly.

Admiral Mahan says in speaking of those times: "To secure one's own people a disproportionate share of the benefits of sea commerce every effort was made to exclude others, either by the peaceful legislative methods of monopoly or prohibitory regulations, or, when those failed, by direct violence."

England's sea power forced Spain to concede the privilege of commerce in the new world to other nations, and in the wars with Holland settled the question as to whether or not the ocean trade of the world was to be open to any people qualified to engage in it.

From now on England's sea power permitted her to take as much or as little of any war as she pleased, and further decided where the fighting should take place. It became a rule that the operations of the British sea power should be felt not in British waters but in the waters of her enemy. The hostile coasts were the frontiers of England.

The war of the Spanish succession gave British sea power a strong position in the Mediterranean. In the Seven Years' War, sea power gave Canada to England and secured her in her rule over India. The increased maritime trade and prosperity, consequent upon an efficient and sufficient sea power, made plain to all the vital importance of sound men in the principal positions in government capable of understanding war and how to conduct it.

In the war of the American Revolution, the Americans won their independence through the aid of French sea power, which at this time was nearly if not quite as formidable as the British.

Napoleon was overthrown by the sea power of England.

The United States in the War of 1812 with England suffered severely, due to the British sea power. If the young nation had had the foresight to build and train a navy proportionate to its maritime commerce, which it should have protected, the end might have been otherwise.

The sea power of the North preserved the Union in our great Civil War. This power by cutting off the trade with neutrals slowly throttled the Confederacy.

The war between Chile and Peru, the Chilean Civil War, the Chinese-Japanese War, each was decided by sea

power. The present war in Europe will be decided by that same irresistible power.

For the United States as for Great Britain, sea power is a vital necessity. Without this power we shall be the vassal of those nations who have wisely provided themselves with sufficient naval forces.

The mere building of ships, guns, ammunition and torpedoes is not sufficient. Material is soulless. The conviction of victory must be felt by every citizen of the Republic. This means a supreme faith in our organizations for peace or war.

Athens, Carthage and Rome, each in its day, was a great sea power. Each lost the sea when the initiative of the fighting men was taken away from them. When the naval leaders could no longer control their own actions, being directed by a jealous and uninstructed political system at home, naval power declined.

The surest test of naval defeat lies in faulty administration of naval affairs. This fact is written on every page of history. Let us therefore look to our naval organization, for upon that rests more than upon any other factor, the safety of our country and the lives of her citizens.

CHAPTER X

THE FLEET

SHIPS traversed the seas carrying merchandise before the idea of a warship was conceived. Trade rivalry between citizens of different nations soon caused friction, translated into acts of violence against peaceful ships, merchandise and merchant sailors. To give protection to this commerce special ships were required for the transportation of soldiers across the water. Merchant vessels likewise carried on board soldiers for protection.

Soldiers fought on land many centuries before they fought at sea. What then was more natural, that the known methods and principles of land warfare were applied when it became necessary to fight on the water.

Ships carrying soldiers when attacked were forced to defend themselves. On land numbers had usually brought victory, hence the ships grew in size in order to be capable of carrying a plurality of soldiers and to provide ample deck space for the wielding of their weapons. On land victory had been won by the soldiers who could be more quickly transported in overwhelming numbers to the crucial point for attack or defense, hence speed and handiness became factors to be considered. In the days of the galleon, oar power was increased to gain speed. The shipbuilding art even to this day finds great length a difficulty. This difficulty the ancients had to contend with in a far greater degree; to obtain speed, therefore, several tiers of oarsmen were used.

Before the days of cannon and for some time thereafter, warships endeavored to range alongside of their enemy and debouch their armed men upon their deck. The Romans invented the "Corvi" or bridge to accomplish this purpose and by its aid flung their irresistible swordsmen in greater numbers upon the decks of the smaller ships of the Carthaginians. The same difficulty

of increasing the length of ships caused guns to be mounted in tiers. To carry a plurality of bigger guns great beam was needed and in consequence size gradually increased. Sail power followed the period of oarsmen. The great French and Spanish three deckers of the eighteenth century, due to their great beam and short length, were slow under sail. They were floating fortresses capable of rapid movement only under a great press of canvas. To engage these ships yardarm to yardarm and carry by boarding was the English adaptation of the idea of the Roman Corvi. In gun power, at point blank range, the more lightly armed yet speedier English ships were no match.

As long as it was possible for the ships to range alongside of an enemy and permit their soldiers to fight on the water in the same manner as on land, it was thought that gun power could not decide an action. Gun power was used in the same general way as is artillery in land warfare, to pave the way for the final assault; to beat down the enemy's morale. This development of what might be called to-day the "Battle Cruiser" idea was the English answer to the big three deckers of the enemy. Speed and handiness in manœuvring were believed to be vital to force an action with an enemy usually unwilling to engage except when in superior numbers.

Afterwards, when warships fought with "clear water" between them, the gun was recognized as the main essential, the end itself instead of the means to an end. The gun usually decided the action. Speed was necessary to bring to action a reluctant foe, but it was not to be gained through a sacrifice of gun power. Soldiers at sea gradually disappeared. Sailors were retained both to work the ship and fight the guns.

Against the destructive effect of gun-fire armor was introduced. Even in the days of wood the sides of warships were heavily timbered. Later anchor chains of iron were used, hung along the outside and lashed. Again size was increased to carry this added protection.

Sail gave place to steam propulsion, and wood to iron and then to steel.

The basic principle under which the warship owes its conception and evolution, "to permit soldiers to fight each other on the sea," was now contained in the words "gun power." Ships were armored in the same way and for the same purpose as were individual soldiers on shore: to protect the fighting man's vitals against the enemy's gunfire.

Cavalry on land, for the purpose of scouting and reconnaissance, gave the idea for the evolution of the frigate and later the cruiser, a descendant of the former.

The true fighting ship, the infantry of the seas, the battleship, continued to increase the size and multiply the number of its guns, starting afresh at the beginning of each cycle which marked a revolution in construction or in the method of propulsion. Its armor protection increased to keep pace with its enemy, the gun. Size, therefore, steadily increased to embody what was considered the essential characteristics.

Iron and steel ships began by following closely the general lines of the old wooden warships. Guns were at first carried in broadside. Ships' sides were protected by heavy iron or steel armor.

The American monitor began a new cycle in warship construction. It was not an evolution from previous warship types; it was a revolution in type; a new idea, embodying a new principle in ship building. From this type followed in due course the turret battleship. This improved type did not arrive immediately. The natural conservatism of the sea first had to be overcome.

Gun power and armor protection slowly developed in effectiveness. Advances in the industrial arts greatly accelerated development. Size gradually increased to carry the added weight of guns and armor. Length being still a restricted dimension, great beam developed and draft increased, making navigation of harbors more difficult and necessitating greater and more extensive facilities for construction, repair and maintenance.

The battleship of to-day is the lineal descendant of the "Triremes" of Actium and the "Ships-of-the-Line" of Trafalgar. It is intended to play the principal rôle in naval warfare. It carries guns of the largest calibre and the vitals and personnel are protected by thick steel armor. With this great weight to carry its speed has been maintained moderate. The United States began by building coast defense battleships, but soon discarded the type and now builds battleships with a larger radius of action than any other nation.

The idea of a coast defense battleship betrays the conception of a soldier, not a sailor. The aim was to produce a fort with sufficient mobility to move to a threatened point of attack. Speed was sacrificed to gun power. Such a vessel was therefore in danger of attack and destruction from several faster but less heavily armed vessels. Armor consequently was used to make the slow ship invulnerable from attack. A squadron of coast defense vessels was the next step. The sailor soon found out the utter unreliability of this type of warship. It was unhandy at sea, too unstable a gun platform for accurate gunnery and when joined with thoroughly seagoing types of warships became a care rather than a re-enforcement.

The coast defense battleship, having failed the soldier, commenced erecting forts at the entrance of each harbor along our great coast line; millions of money have thus been expended and yet our shores are not protected. If the original conception of mobile guns had been logically carried out, using the only element with which the soldier was familiar, the land, then mobility would have been gained by placing the guns on wheels and building roads to give mobility. This would in time have developed great howitzers on railroad trucks with cement emplacements at various places and a strategic railroad running the entire length of our coast lines.

In the development of stationary defenses only a very small proportion of all the coast guns can be utilized

against an attacking enemy, thus a great many guns must lie idle, and, for defense, are useless. With several centrally located artillery parks in the interior connected by railroads to strategical points and with a coast railroad, our entire artillery reserve could be brought to action, wherever needed. This appears to be the logical adaptation of coast defense.

There is a type of vessel often confused with the coast defense vessel. Its conception is based upon the theory that an enemy base is the natural point of attack and not his fleet. It is the land warfare idea that the best method of defeating an army is to seize and cut off from him his base of supplies.

To attack an enemy's fortified base from the sea a very formidable vessel is required. It must have guns for outranging the shore guns. It must be protected from the underwater attack of torpedo-carrying vessels. For this purpose it should be of great size and virtually unsinkable. Its speed need not be great, for there would be no enemy vessel surface or submerging type, capable of defeating it. Its duty would be to completely destroy the enemy's source of supply and thereby render his fleet derelict. Such a vessel has never actually been wholly developed, although the idea has appeared several times in battleship construction and later in the English monitors. It is a purely offensive type, carrying great gun power, heavy armor and some form of underwater protection coupled with shallow draft.

Modern Types and Their Use in War.—In a modern fleet there exist the following types of ships:

(*a*) Battleships ....Compose the battle line.
(*b*) Battle cruisers ....Next in importance to the battleship.
(*c*) Armored cruisers ....A link in the evolution of the battle cruiser.
(*d*) Protected cruisers ...A link in the evolution of the battle cruiser.
(*e*) Scout cruisers ....A fast cruiser to act the "eyes" of the fleet.

(*f*) Destroyers .... For attack upon the battle line, using the torpedo.
(*g*) Submarines .... A weapon of opportunity against the battle line.
(*h*) Repair ships .... Floating machine shops—to repair hull and machinery of vessels of fleet.
(*i*) Ammunition ships ... Carry reserve ammunition and torpedoes.
(*j*) Supply ships .... Carry material supplies for repairs; also food for personnel.
(*k*) Fuel ships .... Carry coal and oil to refill bunkers of vessels.
(*l*) Destroyer tenders .... Carry supplies, ammunition, torpedoes for destroyers.
(*m*) Submarine tenders ... Carry submarine stores and facility for repairs to submarines—also quarter the crews in port.
(*n*) Hospital ships .... Take care of sick and wounded.
(*o*) Mine depot ships .... Carry large supply of mines to be used in active service against an enemy.
(*p*) Mine-laying ships .... Special vessels, fitted to lay mines.
(*q*) Gunboats .... Miscellaneous uses.
(*r*) Tugs .... Miscellaneous uses.
(*s*) Miscellaneous .... Miscellaneous uses.

The battleship has long been regarded as the embodiment of the sea power of a nation. Its principal armament is the gun placed behind protective armor. Upon each battleship as many guns of the maximum calibre as is practicable are carried. The *battle line,* composed of those vessels upon which the maximum calibre guns are mounted, thus contains the concentrated fighting strength of the nation.

The battle cruiser, likewise, is armed with a maximum calibre of gun. The number of guns carried, however, is fewer and the armor protection is less than the battleship. In outward appearance the battleship and battle cruiser are similar. The weight of guns and armor protection dispensed with by the battle cruiser is utilized in

additional speed. These cruisers' speed is sufficiently great to permit them to separate from the battle line to gather information of the enemy and yet be able to return in time to take part in the main action before its beginning.

Armored cruisers and protected cruisers are the precursors of the battle cruisers, merely links in the chain of evolution. They are armed with guns of smaller calibre than the battle cruiser and carry less weight of armor protection. Although no more of these types will be built, their usefulness is considerable.

Scout cruisers are a development of cruisers—very speedy, lightly armed, practically no armor, of moderate tonnage. They are essentially information gatherers, likewise denying information. The very fast scouts, when strongly supported by battle cruisers, are very effective to slip by the enemy's vessels, seeking to keep secret their own fleet's movements.

Destroyers are swift vessels of small size armed with torpedoes for offensive work and guns for defensive work. They attack at night by surprise or in the daytime while the two opposing fleets are occupied in a duel with guns.

Submarines are yet weapons of surprise—their offensive weapon is the torpedo.

These are the combatant types. The others go to make up the fleet's floating base. The need for such a mobile base might not be at first apparent. The need of a base for a fleet is of course understood by most of our citizens. One of our foremost living naval authorities thus describes the complementary character of a base and the fleet:

"The effective range of the fleet itself, taken as a projectile, since so taken it properly may be, its radius of effort is determined by the consideration that the fleet upon leaving its base may roam and operate for a certain space in time and distance, but must never lose the power of safe return to that base, in default of other secure refuge for renewing its supplies and restoring its strength

—of course this effective range will gradually change with the changing size and consequent endurance of the constituent units of the fleet. Thus, everything capable of inflicting damage, shot and shell, mines, torpedoes, fleets and armies, may be regarded as missiles to be thrown from the base, and the base itself as a great battery arsenal and storehouse of power."

Now, if we build a fleet without at the same time providing such a base, we commit the error of providing a projectile without obtaining the gun to fire it.

It is equally plain that no nation can afford to build an unlimited number of permanent bases for its fleet. It should provide bases at important strategical points, but can be expected to go no further. In peace we cannot always know exactly where our bases should be located. In war it may be necessary to operate and base the fleet upon a locality where no base has been provided. The mobile base therefore takes care of this contingency. The fleet sails for its selected base, taking along with it the "train," composed of special vessels in whose hulls are contained all that is required to renew its supplies and restore its strength. These vessels are those listed below the combatant units. They form a vast armada and en route oversea are a source of much anxiety to the fleet dependent upon their facilities. Until the train is safely moored inside the base selected, the fleet is, of necessity, greatly curtailed in its operations. The loss of the train would, similarly to cutting off an army from its base, force the fleet to abandon its voyage and return to its nearest permanent home base.

Naval thought for centuries has differentiated warships into three classes: Battleships, Cruisers and Flotilla.

In Nelson's day these were the line of battleship, the frigates, and the flotilla. The latter consisting of many small sailing ships, used for various purposes, usually in home waters.

To-day it is the dreadnought, the battle cruiser, and the destroyer and submarine.

The great sea power, England, has held to the theory that the object of naval warfare is to control communications. The control of communications in the past has always given her victory. The control requires a large number of ships, for a large area of ocean must be covered by the nation ambitious to control the communications of the world or even a part of them. Cruisers and flotilla were used. The heavy fighting ships, the line of battleships, were held as a menace to the enemy, who dared the exercise of control.

"On cruisers depends the exercise of control;
On the battle fleet depends the security of control."

Control of communications is merely another method of expressing the command of the sea.

As England depended upon the control of communications for her existence, and for control, cruisers were needed, consequently she built a vast number of these fast lightly-armed vessels.

The enemy, in due course, attempted to destroy this control, by attacking it at distant points with heavier ships. These attacks made England consider an effective means of warding off these menaces. The result was the building of warships to support the cruisers. In the days of sail they were intermediate warships, between the frigates and the ships of the line. In latter days these intermediate warships became armored cruisers and battle cruisers.

Although the great sea power considered the control of communications most important, it did not lose sight of the necessity to bring the enemy's fleet to action. For this purpose, cruisers were required to act as the "eyes" of the fleet. These two duties of cruisers and intermediate ships were conflicting—they could not do both at the same time.

The flotilla acted as a home guard, to protect invasion, and to control communications close to home waters.

Now let us skip a hundred years. The flotilla is no longer made up of small merchant ships armed with a few

guns. It consists of destroyers and submarines, armed with very deadly torpedoes. It has become a combatant unit and a very powerful menace to the battle fleet. Until the coming of the modern torpedo the battleship could take care of itself. Now it must be guarded, at night against torpedo attack; in the daytime against the submarine.

The naval term used for guarding is "screening." The battle fleet must be "screened" from observation and torpedo attack.

No longer can England declare the enemy's coast as the place for her battleships.

Admiral Jellicoe will not risk his dreadnoughts close to German ports, as did Nelson with his line of battleships, off Brest, blockading in the French Fleet. Even the control of communications must be, to a limited extent, abandoned, to furnish sufficient cruisers to "screen" the fleet. The cruiser duty is being done in Europe by the flotilla—the flotilla is actually grading into cruisers.

The submarine has brought another factor into the subject of the control of communications. The control of communications means that communications between the home country and other countries will not be interrupted. The submarine has the power to interrupt. It torpedoes and then disappears beneath the surface. This method of interrupting communications was new and almost undreamed of. To meet it the great sea power must utilize a vast number of small armed vessels, both to attack the submarine and to screen the battle fleet from submarine attack. In the control of communications a large number of vessels are required. To guard the fleet and act as its "eyes" a large number of cruisers are required. The battle fleet's insecurity requires a large number of cruisers for both scouting and screening.

In the olden days, a frigate was said to exercise power under cover of the ships of the line. Now the battle fleet seeks safety under cover of the cruiser. The cruiser, having all this weight of responsibility thrust upon it, grad-

ually but nonetheless surely, grew in size and strength equal almost to the battleship itself.

A fleet on the seas must have its force of armored and other cruisers for scouting and screening. Nelson called his fast ships "observation squadrons." In a modern fleet, the battle cruisers and scout cruisers have become the observation squadrons.

The true theory of naval war is not that the object of naval war is to control communications, but that it is simply a means to an end. The end is the destruction of the enemy fighting fleet, wherever it may be found. This being the real object of war, no type of ship should be built that cannot be thrown into the battle.

A modern fleet differentiates itself into groups, in accordance with the primary function each class was designed to serve. These groupings are what has been termed by naval historians the constitution of a fleet. To go a step further we come to the organization of the fleet. This is a further grouping by functions.

Battleships compose the battle line of the fleet. They present to an enemy a solid array of guns and armor. Their duty is to fight the gun duel. This type is usually placed under the command of a leader. The commander-in-chief himself is accustomed to go into action in one of the battleships of the battle line.

Cruisers in a fleet engagement are used as information gatherers. The several grades of cruisers are given duties commensurate with their power. The small scouts spy out enemy movements in advance of their own fleet. When their way is blocked by heavier ships, the armored cruisers and battle cruisers rush forward to support the scouts, thus permitting them to break through the enemy's screening force and discover the enemy's position and strength.

The cruisers likewise drive off those vessels of the enemy who may be endeavoring to gain information. They protect the numerous destroyer flotillas and support *them* in a dash to gain an advantageous position for tor-*pedoing the* [illegible]'s battle line. The cruisers likewise

carry mines and lay mine fields in such localities as may have been designated, endeavoring to entice the enemy's vessels over the mine fields.

Submarines, due to inferior speed, can scarcely be expected, except by mere accident or unforeseen opportunity, to take part in an action. They may, however, be given an area into which the enemy may be driven by superior weight of gunfire. Then the submarines might be able to render, by surprise, a good account of their torpedoes.

Cruisers, destroyers and submarines each are grouped under a leader. A single officer commands all the cruisers. He has several classes of such vessels under him. These classes are further grouped and placed under subordinate leaders. It is the same way with the destroyers and the submarines.

When it is remembered that our battleship force will be composed of about 35 battleships, our cruiser force of an equal number of hulls, and our destroyer force of about 60 vessels, it will be understood that each force must be divided up in order to be tactically handled.

Strategical command is unlimited—a commander-in-chief can command strategically any number of ships. Admiral Jellicoe, at this minute, commands thousands. Tactical command, however, is limited. The larger and less trained the fleet, the smaller must be the division for tactical work.

Intermediate subordinate commanders, even though essential to relieve a leader of details, often retard and weaken the command. If they could all be of one will with the leader, then flexibility would be assured.

The leaders of a fleet should be as permanent as possible. Their training should be in the vessels and with the forces they will command in war.

"The object of fleet organization is to give to our naval forces that flexible form of tactical cohesion that will enable the forces organized to respond most efficiently to the conditions of battle."

The true theory of naval war is that the object is the destruction of the enemy's fighting fleet, wherever it may be found.

Let us imagine our fleet at sea, seeking the enemy fleet, for the object of destruction.

It is daytime. Our battleships are steaming at high speed in four columns, leaders abreast. Far ahead our scouts and battle cruisers are in contact with enemy vessels of similar type. Our destroyers are far ahead, ready to ward off enemy destroyers, also attack the head of the enemy columns with torpedoes.

From the scout contacts develop several duels, scouts against scouts, battle cruisers against battle cruisers. The destroyers on each side hovering around awaiting a chance to get home a torpedo thrust. Meanwhile the enemy are attempting to conceal, our ships endeavoring to gather, information. Such a fight as Admiral Beatty developed with his battle cruisers would be the logical outcome. Once the enemy fleet had been brought under observation, the vital duty then was to hold it there and lead the battle lines together. One would be anxious but the other would be timid and seek to shake off the sleuth hounds.

If a normal battle is fought, then the battle lines draw up opposite each other. The battle cruisers take stations ahead of their respective battle lines. The scouts and destroyers concentrate far ahead of the two battle fleets.

Before the main action between the opposing battle lines has fairly begun, several actions may be in progress. The destroyers, supported by scouts, may be engaged, each endeavoring to win the advantageous position for attack and drive the enemy back to prevent its attack on the battle line. The battle cruisers probably are yet hotly engaged.

After the two battle lines open fire, at opening ranges of from six to ten miles, depending upon weather conditions, then the destroyers, and even scouts, gather themselves together for a nerve racking dash upon the head *of the enemy* column. The enemy battleships must

repulse this attack before theyers arrive within three or four miles, otherwise score of torpedoes are approaching these battleshi:ed at such intervals that a miss is impossible une entire battle line changes course under gunfire.

During the battle, subordinamanders do not look to their commander-in-chief fors. They must have learned his ideas from long an:inuous training during peace. Each commander, ier of a squadron of battleships, a division of destror of a single cruiser, must be capable of grasping :diately the situation confronting him and be ready the appropriate action.

A fleet, whose subordinatmmanders lack right understanding through neglect e higher military education, will not be able to succn battle against a fleet whose subordinate commandeave been co-ordinated in the military sense. The firs:t will find itself inflexible, rigid, ever looking for rs that in the pandemonium of the battlefield canrome. Fleeting opportunities will be omitted beca not recognized. The trained fleet will act as if the seme leader were everywhere. His spirit will rest u the shoulders of each subordinate commander, and ory will be the prize of diligent and painstaking prep:ion.

CHR XI

THE EVOLUTDF THE MODERN DREDUGHT

THE term *Battleshi* corruption from "Line of Battle Ship." A vesssidered large enough and with guns enough to "the line" in battle.

In the early eighteentury a vessel armed with 50 guns was considered to lie in the line. In the latter part of that centuthing smaller than a vessel mounting 64 guns could the line. Later still in the eighteenth century it red 74 guns to be able to lie in the line of battle. The see the gradual growth of battleships. It was not, ever, until the twentieth century that great tonnage doped.

In tracing the evolutof the battleship, to go in detail further back than middle of the nineteenth century would not be instruc, for shortly before that time shipbuilding methods unwent a complete transformation; steel and iron replacwood, and steam crowded out sails. We shall thereforegin with contemporaries of the American monitor.

The British "Royal Sereign," with five big guns in four turrets, and the "nce Albert," with a similar number of gun turrets, ctemporaries of the American monitor, 1860–1864, werectually in advance of battleship evolution. These veels were masted turret ships, using both steam and sa power. Then followed the classes exemplified by thill-fated "Captain" and the "Devastation," each a turet ship. But here for a time progress in turret ships car to a stop; the weight of ideas of the day turned to a morclose imitation in the iron ship of the well-known and sucessfully tried out features of the wooden ships that preceded them.

Progress in warship construction has always had to contend with what seems the almost unpardonable con-

servatism of seamen. Upon the introduction of steam propulsion, the Naval Lords of the Admiralty were strongly prejudiced against having anything to do with such a new-fangled invention. Their desire was to repeat the construction of the line of battleships propelled by sails alone, similar to those that fought successfully under Nelson. Their argument was: They were good enough for the great Nelson and therefore good enough for any-one. The consequence was the introduction of steam in warships was forced upon the Admiralty by the Civil Lord against the advice of his naval advisers. This is one case where a civilian is often a better judge of the course of progress than those whose opinions are prejudiced by both sentiment and tradition.

This same conservatism of seamen had to be over-come when the iron and steel construction of warships replaced that of wood, and as a rule whenever a sweep-ing change in administration or training is seen to be needed. An example in point was the change in target practice methods in our navy made nearly twenty years ago.

It will be seen that the path of warship construction has had many turnings and not a few blind alleys, where footsteps have to be retraced.

Several navies held doggedly to the conviction that what was wanted was a large number of lesser calibre guns on several decks. France and Turkey adhered to heavy guns in broadside with many smaller guns placed wherever space was available, and all protected by armor of varying thickness. Italy and Russia followed England and experimented with turret ships. In the "Italia" and "Dandolo," 1878–1880, Italy produced a type of battle-ship very formidable in gun power and of high speed considering the stage of steam engine development. The "Italia," although carrying four 100-ton guns, was pro-vided with no side armor and in consequence was believed very vulnerable to attack from the plurality of smaller calibre guns carried in contemporary warships.

TABLE I

Comparative Pre-Dreadnought Evolution from 1890

Date Laid Down	Name (class)		Gun Power		Maximum Armor		Maximum Speed		Normal Displacement	
	United States	England	United States	England	United States	England	United States	England	United States	England
1891	Oregon	....	4–13″ 30 cal. 8– 8″ 35 cal.	....	18″	....	17	....	10288	....
1893	Iowa	Magnificent	4–12″ 35 cal. 8– 8″ 35 cal.	4–12″ 35 cal. 12– 6″ 40 cal.	14″	9″	17	17.5	11346	14900
1896	Kearsarge	Albion	4–13″ 30 cal. 4– 8″ 35 cal.	4–12″ 35 cal. 12– 6″ 40 cal.	16.5″	6″	16	18.3	11520	12950
1897	Alabama	Canopus	4–13″ 35 cal. 14– 6″ 40 cal.	4–12″ 35 cal. 12– 6″ 40 cal.	16.5″	6″	16	18.5	11520	12950
1899	Maine	Venerable	4–12″ 40 cal. 16– 6″ 50 cal.	4–12″ 40 cal. 12– 6″ 45 cal.	11″	9″	18	18	12500	15000
1901	Georgia	Queen	4–12″ 40 cal. 8– 8″ 45 cal. 12– 6″ 50 cal.	4–12″ 40 cal. 12– 6″ 45 cal.	11″	9″	19	18	14948	15000
1903	Connecticut	King Edward	4–12″ 45 cal. 8– 8″ 45 cal. 12– 7″ 50 cal.	4–12″ 40 cal. 4–9.2″ 45 cal.	11″	9″	18	19	16000	16350
1904	Idaho	Lord Nelson	4–12″ 45 cal. 8– 8″ 45 cal. 8– 7″ 50 cal.	4–12″ 45 cal. 10–9.2″ 50 cal.	9″	12″	17	18.5	13000	16500
1905	New Hampshire	Dreadnought	4–12″ 45 cal. 8– 8″ 45 cal. 12– 7″ 50 cal.	10–12″ 45 cal.	9″	11″	18	21	16000	17800
1906	South Carolina	Superb	8–12″ 45 cal.	10–12″ 45 cal. 16– 4″ 50 cal.	11″	11″	18.5	21	16000	18600

The United States after the Civil War failed to continue the development of warship types and gave practically nothing worth while to help evolution during a period of twenty-five years.

After 1880 the idea of the big guns mounted in armored turrets obtained a firm footing. Lesser main battery guns were supplied in addition and light quick-firing guns were located wherever possible for resisting the attack of the torpedo boat, which in the early eighties began to be seriously considered as a menace to the big ship.

In 1891 the United States laid down three ships of the "Oregon" class, carrying a battery of four 13-inch and eight 8-inch guns. These vessels in their ordnance development were in advance of the development in other navies. Unfortunately, through the absence of a definite naval policy controlled by an intelligent general staff, the United States failed to take profit in the achievement. In the "Alabama" class we find the United States blindly following England.

Ten years later the "Georgia" class was laid down, in which the battery power of the "Oregon" class was repeated in more modern guns of greater length. If the United States had advanced the development of the "Oregon" and "Iowa" class, instead of abandoning it from sheer lack of self-confidence in its own decisions, the dreadnought certainly would have appeared in this country several years earlier.

The United States from 1897 to 1900 followed England in pre-dreadnought design, but in 1901 with the laying down of the "Georgia" class the former again asserted its independence. This vacillating shipbuilding policy of the United States blocked further development until 1906, when England's lead was again followed in the "South Carolina" class.

Immediately before the advent of the dreadnought a strong tendency toward this type in shipbuilding was shown in an increase in size of the medium calibre guns and placing them in armored turrets. The table on the following page exemplifies this attempt toward perfection.

England achieved the honor of foreseeing the next step and unhesitatingly took it; the dreadnought was the result. Its building marked a new era in battleship construction. This vessel gave the name dreadnought to the type.

So far an endeavor has been made to trace the evolution of the warship from the earliest known records down to the dreadnought. We have seen that size or displacement, whichever term is preferred, always in the aggregate has increased.

TABLE II

Date Laid Down	Country	Name (Class)	Battery
1901	United States	Rhode Island	4–12″ 40 cal. in turrets. 8– 8″ 45 cal. in turrets. 12– 6″ 50 cal. in turrets.
1901	Italy	Vittori Emanuela	2–12″ 40 cal. in turrets. 12– 8″ 45 cal. in turrets.
1902	England	King Edward	4–12″ 40 cal. in turrets. 4 9.2″ 45 cal. in turrets. 10– 6″ in broadside.
1903	France	Justice	4–12″ 50 cal. in turrets. 10– 7.6″ 45 cal. in turrets.
1903	United States	Connecticut	4–12″ 45 cal. in turrets. 8– 8″ 45 cal. in turrets. 12– 7″ 50 cal. in broadside.
1904	England	Lord Nelson	4–12″ 45 cal. in turrets. 10– 9.2″ 50 cal. in turrets.

The final decision for the dreadnought type came about as a result of gunnery development. The dreadnought doubtless appeared earlier than otherwise, due to the strong pressure of those who had forced intensive gunnery training. When long range firing came into prominence the difficulty in controlling accurately the fire of the several calibres of guns mounted on board the pre-dreadnoughts was a strong argument for the appearance of a "one-calibre big gun ship." Salvo firing was found to simplify *fire control*. The entire broadside was made to land as *one great splash*. Furthermore, a concentration of fire,

by which is meant placing the fire of two or more ships upon a single ship of the enemy, usually the leader, was seen to be a valuable tactical or gunnery achievement. It was evident that efficient concentration of fire demanded

TABLE III

BRITISH

Date Laid Down	Name (Class)	Heavy Guns	Belt Armor	Max. Speed (Knots)	Normal Displacement
1905	Dreadnought	10–12″ 45 cal.	11″	21	17900
1906–07	Superb	10–12″ 45 cal.	11″	21	18600
1907–08	St. Vincent	10–12″ 50 cal.	9.75″	21	19250
1908–09	Colossus	10–12″ 50 cal.	10″	21	20000
1910	Orion	10–13.5″	12″	21	23000
1911	Audacious	10–13.5″	12″	21	23000
1912	Iron Duke	10–13.5″	12″	21	25000
1913	Queen Elizabeth	8–15″	Unknown	25	27500
1914	Royal Sovereign	?–15″	13.5″	21	25750
1915	Repeating Queen Elizabeths and Royal Sovereigns.				

UNITED STATES

Date Laid Down	Name (Class)	Heavy Guns	Belt Armor	Max. Speed (Knots)	Normal Displacement
1905	....	....	....	....	......
1906–07	South Carolina	8–12″ 45 cal.	11″	18.5	16000
1907–08	Delaware	10–12″ 45 cal.	11″	21	20000
1908–09	Florida	10–12″ 45 cal.	11″	20.75	21825
1910	Wyoming	12–12″ 50 cal.	11″	20.5	26000
1911	Texas	10–14″ 45 cal.	12″	21	27000
1912	Nevada	10–14″ 45 cal.	13.5″	20.5	27500
1913	Pennsylvania	12–14″ 45 cal.	13.5″	21	31400
1914	California	12–14″ 45 cal.	13.5″	21	32000
1915	....	....	....	....	......

GERMANY

Date Laid Down	Name (Class)	Heavy Guns	Belt Armor	Max. Speed (Knots)	Normal Displacement
1905	....	....	....	....	......
1906–07	Nassau	12–11″ 45 cal.	11.5″	19.5	18900
1907–08	Helgoland	12–12″ 50 cal.	11.5″	20.5	21000
1908–09	Kaiser	10–12″ 50 cal.	14″	20	24700
1910	Kaiserin	10–12″ 50 cal.	14″	20	24700
1911	Koenig	10–12″ 45 cal.	14″	21.5	25575
1912	Kronprinz	10–12″ 45 cal.	14″	21.5	25575
1913	Ersatz Worth	8–15″	?	23	28000
1914	Ersatz K. Frederich	8–15″	?	23	28000
1915	....	....	....	....	......

TABLE III—*Continued*

JAPAN

Date Laid Down	Name (Class)	Heavy Guns	Belt Armor	Max. Speed (Knots)	Normal Dis-placement
1905	....	....	....	.....	.....
1906–07	....	....	....	.....	.....
1907–08	....	....	....	.....	.....
1908–09	Kawachi.........	12–12″ 45 cal..	12″	20	21420
1910	....	....	....	.....	.....
1911	....	....	....	.....	.....
1912	Fuso............	12–14″ 45 cal..	?	23	30600
1913	Not named.......	12–14″ 45 cal..	?	23	30600
1914	Not named.......	12–14″ 45 cal..	?	23	31000
1915	....	....	....	.....	.....

ITALY

Date Laid Down	Name (Class)	Heavy Guns	Belt Armor	Max. Speed (Knots)	Normal Dis-placement
1905	....	....	....	.....	.....
1906–07	....	....	....	.....	.....
1907–08	....	....	....	.....	.....
1908–09	Dante Alighiere..	12–12″ 46 cal..	9–—″	23	18400
1910	Conte de Cavour.	13–12″ 46 cal..	9–¾″	22.5	22000
1911	Guilio Cesare.....	13–12″ 46 cal..	9–¾″	22.5	22000
1912	Caio Duilio......	13–12″ 46 cal..	9–¾″	22.5	22000
1913	....	....	....	.....	.....
1914	C. Colombo......	8–15″.......	?	25	30000
1915	....	....	....	.....	.....

placing as many as possible of the biggest calibre guns in a single unit. *Two* "dreadnoughts" could concentrate their twenty-four guns upon a single enemy ship with expectations of a larger percentage of hits than an equal number of guns mounted in six ships. In the former case only two minds controlled, while in the latter six minds were involved with the vastly greater chances of confusion and in consequence less efficiency in hitting power.

To accomplish the dreadnought idea tonnage received a sudden impetus, and at the present writing it is yet increasing, having reached beyond the thirty thousand ton mark.

In Table III the development of the dreadnought type since 1905 is traced for several of the great navies. Speed

has been maintained nearly constant, guns and armor were the variables. In 1913 England, Germany and Japan each laid down dreadnought battleships whose speed was to be several knots greater than earlier ships. This decision for speed was a tardy recognition of a principle that history had exemplified in the victories won by England's great seamen, Drake, Rodney and Nelson: "Superior speed is required in order to force an engagement upon a reluctant enemy."

If we return to our definition of battleship—a vessel considered large enough and with guns enough to "lie in the line" in battle—we shall have to consider very seriously as to what is a battleship. For instance, if the "line of battle" were composed of Queen Elizabeths, Pennsylvanias, Ersatz Worths or C. Colombos, then would we be justified in putting such warships in the line of battle as the "Alabama," "Georgia" or "Connecticut"? The answer is, of course, no, and for this reason we must constantly replace old battleships with more modern, not because the ships wear out but they cease to be battleships. They are still useful, however, for many purposes and should be retained in service.

CHAPTER XII

THE CRUISER

The importance of this type of warship warrants no less than a chapter exclusively devoted to it.

The frigate is the ancestor from which all cruisers have descended. It is said to get its name from a Greek word meaning "unguarded"; thus, a vessel without means of defending itself. The first frigates were small, swift, undecked vessels propelled by oars or sails. They depended upon their heels. The Portuguese used such vessels, without guns, in the East Indies during the sixteenth and seventeenth centuries. The term frigate was finally applied to a warship, coming next in rank to ships of the line used for cruising and particularly for scouting purposes. Frigates as a standard class of warship were ship-rigged, carried their guns on a single deck and on a raised top-gallant forecastle and poop deck. The number of guns carried ranged from twenty-four to fifty.

Nelson, more than any of the great admirals, bemoaned the lack of frigates to be used to search for and keep in touch with his country's enemies on the sea. Frigates of his time were lightly sparred, carried a vast spread of canvas and were much faster than the line of battleships. They were not called upon ordinarily to fight in the battle line, in consequence great beam was not required and good underwater form for speed was possible. The frigate could outsail any warships which might mount a heavier battery than she herself carried.

This was the type of warship built by the United States under the guidance of Joshua Humphreys in the last decade of the eighteenth century. At this time the commerce of the new Republic was growing rapidly. Some measure of protection was necessary. It was then natural enough that the decision was for fast warships, capable of covering great distances, able to fight all war-

ships, except line of battleships, and with the speed to bring them to action. Humphreys built frigates more than a match for contemporary British ships of the same class.

The United States built but few line battleships during the era of wood construction. It remained content with lightly armed but very speedy warships.

When iron and steel were introduced, outside of the monitors, which were a development of the Civil War, the United States first laid down cruisers. The infancy of the art in this country probably restricted ambitions. At all events, the "Dolphin," "Boston," "Chicago" began a new era for the navy. To digress, the ill-fated "Maine" and the "Texas" were the first actual steel line of battleship types built in this country; these were followed by the "Oregon," "Massachusetts," "Indiana" and "Iowa."

In the early nineties the United States Fleet consisted only of cruiser types. When the Japanese fought with China in 1894, China had two line of battleships. Japan had cruisers only. Cruisers, of necessity, on both sides "lay in the line."

Dewey fought the Battle of Manila Bay with cruisers. Sampson at Santiago fought his cruisers in the line with his battleships.

In the early development of a navy, primary functions of each class of ship cannot always be considered. With the enemy before them, all ships must join in the battle.

It has been only within the last two decades that cruisers have, as it were, specialized in their duties, thus beginning a type of warship for a special and distinct service.

It has been explained that the "control of communications by sea" has been the real impetus behind cruiser evolution. Nations desiring to safeguard their own merchant shipping and destroy an enemy's recognized the need of numerous fast warships. Rivalry in cruiser construction naturally increased tonnage, number and size of guns

carried, and added armor protection. Thus, from the small protected cruiser grew the armored cruiser, and from the latter the battle cruiser appeared.

The duty, as the "eyes" of the fleet, was never lost sight of, but the control of communications was considered of more vital importance.

Many have asked and, among these, a large proportion of persons well versed in naval matters, "Why are battle cruisers built, and if they have been recognized so long as necessary, why is it that the United States has none in her fleet?"

The answer to this is not one that can be answered in a few lines. Indeed, it would more properly cover more space than a chapter. However, the question requires answering. When the battle cruiser "Inflexible" visited New York several years ago, the above question was heard on all sides; thinking Americans, in all walks of life, wondered why other nations laid so much stress on battle cruisers; nations, too, whose naval policies are more carefully thought out, uninfluenced by internal politics, and adhered to, than is possible under our form of government.

The United States Government has omitted battle cruisers from the building program, not because the weight of opinion of her naval strategists and tacticians was against the type, but because the appropriation for naval increase has been a limited one, and the naval advisers have adhered to the rule that, before thinking of meeting an enemy, it was wiser to consider being able to contend with him. Therefore all available money had been put in battleships, destroyers and submarines, for it was thought these were the types required to contend with an enemy fleet. A ship of the "Lion" type costs to build as much as, or more than, a battleship of the "New York" type. A battleship is provided with armor over its vitals capable of resisting penetration from the heaviest projectile fired at battle range, or about 12,000 yards. *Therefore, two opposing* fleets of battleships would theoreti-

cally, fighting at a range greater than this minimum, simply expend their store of shot and shell without dealing a deathblow to a single ship of the enemy's fleet; though this will not be true practically. And the explanation is quite simple. In order to defeat an enemy it is not necessary to penetrate the armor of his battleships with your projectiles; it is better to demoralize the personnel by a hail of high explosive shells, by riddling the smoke-stacks, by exploding shells in the ventilating supply, and thus turn the still invulnerable battleship into a charnel ship, an easy victim for the preying destroyers and submarines. Of course some armor betrays its trust and allows itself to be penetrated.

A cruiser might be described as a battleship with guns shaved down, as it were, and its armor thinned down to nearly one-half the thickness, and this saving in weight given to the motive power, producing a cruiser of as much as five or six knots faster than the battleship.

In our armored cruisers of the "Maryland" and "Memphis" class, the only classes that are dignified enough to bear the name of armored cruiser, not only has the armor been sacrificed, but the guns have been shaved until they are, against an enemy with a squadron of "Inflexibles," practically useless.

An "Inflexible" could destroy either a "Memphis" or a "Maryland" at extreme range without receiving enough punishment to note in the ship's log. This was demonstrated at the Falklands.

The last in commission of our armored cruisers, the "Tennessee," now the "Memphis" (recently lost off San Domingo), is the most modern we shall have until the recently provided battle cruisers are built. If, then, armored cruisers—battle cruisers—are necessary, what shall we do without them in case we are suddenly plunged into war with a nation that has battle cruisers?

The armored cruiser's main duty is to drive in by superior force the enemy's advance screen and discover the whereabouts and strength of the enemy's main body,

or to be used as an irresistible screen around its own fleet in order to prevent the scouts of the enemy, be they armored or unarmored, from breaking through in order to obtain necessary information. Now, then, how can our poor little " Memphis " type be ruthlessly pitted against " Inflexibles " or " Lions " in carrying out their important duties?

Let us imagine a concrete case and study it progressively. Our policy has been to use all the money given by Congress each year to build one-calibre gun battleships of about twenty-one knots speed. Our probable enemy across the water, whom we shall call "A," for simplicity, has outlined a building program which provides for one battle cruiser for every two battleships laid down.

We shall purposely leave out of the discussion the phases of strategy and tactics leading up to the battle and the part in the phases played by the battle cruiser. We start with the encounter where both fleets are in sight and both intent on giving battle on the best terms possible.

Suppose that in two years from to-day the United States shall have in commission sixteen one-calibre gun-ships of twenty-one knots speed and no battle cruisers, while "A" has in commission eleven battleships and five battle cruisers of twenty-six knots speed. If "A's " battleships are " New Yorks " and her cruisers " Lions," the United States, with her sixteen homogeneous " New Yorks," will be the better prepared, for when the day comes for the big fight which alone can decide the war, " A " will be forced to put her " Lions " into the fighting line in order to number sixteen against the United States Fleet. Where then is the advantage of this twenty-six knots speed, and how disadvantageous will be the thin armor of the battle cruisers, not to mention the loss of a 15-inch turret or two, sacrificed to give this speed, which cannot be used?

This is the manner of argument of those who are against aught but battleships, and it has a fine, convincing *sound, but* can we be sure that every country with whom

we may have differences which cannot be settled amicably will total up equal only in its battleships and cruisers to our battleships? This is the condition that we must carefully watch, for the battle cruiser becomes strikingly dangerous when it can be given a free rein to carry on the fight in its own particular way.

Again, suppose in the next two years a country, call it "B," in addition to its battleship needs, builds "Lions" to be used in the war cloud some have already seen approaching. What then shall we do if "B," our enemy, lines up battleship for battleship, sixteen leviathans of the one-calibre gun type, and in addition eight or even six battle cruisers?

It seems hardly necessary to say that we would be in a very disagreeable and awkward situation. Our poor "Memphis" and "Sacramento" class would be forced to seek protection under the lee of their battle line. It would in fact be more merciful to have left them at home.

The admiral in command of the United States Fleet would feel very sore at heart and no doubt convince himself that he had always advocated building battle cruisers in addition to battleships and demanding the additional appropriation from Congress.

Opposite him, just out of gun range, he can count sixteen of the most modern dreadnoughts, each the peer of any of his own ships. He had been attempting to engage and have it over with for nearly an hour, but the admiral of the enemy seemed to wish to play with him, to enjoy the grand spectacle as long as possible before marring the picture with a smudge of destruction and death. The American admiral would cast many an anxious glance at his charges, his obsolete armored cruisers under his lee wing. Graceful, and in their day speedy, but, as he might remark testily to his chief of staff, "armed with shotguns, by Gad."

Then from out the murky atmosphere a fringe of black smoke caught the admiral's eye. It was ahead of the enemy's fleet. It was not long before the Americans

were let into the secret of this new smoke. Six mighty battle cruisers came like cavalry charging directly down on the head of the American column until they reached a range to worry the American line, and then swung to cross the T and opened fire with their fifteen-inch guns on the four leading American ships. The admiral had taken refuge in his armored tower and scowled at the sixteen battleships of the enemy, calmly waiting battle. What should he do? What could he do? The cruisers' fifteen-inch shells were exploding aboard his ships. His men were becoming demoralized. They did not understand the finesse of naval strategy. All they understood was that they were getting hammered and could not hit back.

The admiral knew that if he opened fire on the cruisers with the bow guns of his leading ships he would expend a large amount of precious ammunition, which he would need in the battle that would soon come, but if he did not open fire the four leading ships of his fleet would go into the big fight with a millstone about their necks. The six cruisers still hung on and the American admiral wished for the proverbial magic wand to turn his obsolete cruisers into "Lions" to drive off the tenacious cruisers of the enemy.

Which did the admiral do? Expend a large part of his valuable ammunition to drive off the six battle cruisers and begin the action with many of his magazines half depleted, or stand the punishment being dealt him by the enemy's "Lions" and go into action with maybe even a greater handicap?

To follow this imaginary action further:

After the six cruisers have continued for some time with almost perfect safety, having, indeed, held battle practice on real live targets and made a creditable number of hits, as told by the frequency of the admiral's oaths, they gracefully withdrew and the "B" admiral suddenly advances with his fighting fleet and the action begins.

Now there are two good moves for the six idle monsters. One is to go over on the lee side of the Americans

and have another target practice on the " Memphis " and " Marylands " without fear of molestation from the American battleships, for they dare not withdraw a single big gun from the main action (all of our turrets are on the middle line of the ship, permitting all guns to bear on both broadsides), and the other way is to stay where they are, far up on the bow of the American line, and at long range concentrate on the leading American ships, thus augmenting the fire tremendously from a commanding position, which would soon decide the action. The twenty-five knots speed of the " Lions " will permit their holding continuously this position of tactical advantage.

The battle cruiser with fewer guns cannot fight a battleship; if it does it must theoretically lose the battle, but its use will be in convoying transports and in scouring the seas. If the enemy have "Inflexibles" and "Lions" and we have not, how then shall we convoy our transports? We cannot use our " Memphis " and " Sacramentos "; it must be only with battleships, for we dare not leave our soldiers at the mercy of the enemy's battle cruiser.

How shall we meet a raid on our coast towns—those without fortifications? This method of warfare may soon be forbidden by international agreement, but it is not yet; therefore we must prepare for such emergencies. The enemy's reason for this kind of attack by naval vessels is to cause a general feeling of fear and insecurity among the people of the coast towns, hoping that the outcry will be powerful enough to hamper the movements of the fighting fleet.

This can be met only with as powerful vessels as the enemy will send to carry out its purposes.

Naval strategists lately have brought forward a solution to the question of the battle cruiser which has gained great popularity among American naval officers; indeed, it seems to satisfy both schools—those who advocate only battleships and those who would like to see a proportion of " Lions " in our battle fleet. The solution is sacrifice some armor but increase both gun power and speed.

As hinted at above, the battle cruiser is figuratively a battleship, some of whose armor and gun power has been sacrificed for five or six knots increased speed. Now in sacrificing gun power you take away its offensive power—reduce the force of its " punch," but in sacrificing armor, no offensive power is disturbed. You must depend for protection upon being the attacking side and deliver a more accurate and sharper sustained fire than the enemy.

Armor is purely defensive. Its use is warranted when superior gun power and higher speed than enemy ships also can be obtained.

The Confederate armor-clad " Merrimac " fought and sank the wooden frigates of the Union. Gun power and the ram won the action. The armor of the " Merrimac " was not penetrated. The " Merrimac " was the attacking vessel.

The " Monitor " defeated the " Merrimac." Superior gun power and handiness were the causes attributed. The armor of the " Merrimac " was penetrated and she was in danger of being rammed by the handier and faster ship. The armor of the " Monitor " was not penetrated. The " Monitor " was the attacking vessel.

In more recent naval actions heavily armored ships have been defeated, yet their armor scarcely has been penetrated. Examples are the Chinese battleships at the " Yalu " and the Russian ships off Port Arthur and at Tsushima. These vessels owed their defeat to the effective gun power of their enemy causing a breaking down in morale. " The best protection against an enemy's fire is a well-directed and sustained fire from your own guns."

We have historical precedents in the abolition of armor protection.

Geological records show us the gradual elimination of purely defensive adaptations of the body in animals. The turtle family, the scaly Saurians were purely defensive types. These gigantic but slow-moving quadrupeds have *failed to* survive. They have been unable to withstand

the attacks of those animals in which "mobility" and the power of combined action has been predominant. Surviving types as a rule contain a happy balance of those offensive attributes, activity, endurance and intelligence, translated into claws and teeth, limbs and muscles and a hereditary instinct to combine in packs for the attack upon a more powerful foe.

Nature is a faultless organizer, yet even she arrives at perfection only through a selection of organs essential to an environment. Man unconsciously follows nature's methods, but only in a rambling and uncertain way, which requires a longer time to arrive at a result desired.

On land the soldier protected his vitals with armor. In the days of stones and arrows fighting men wore hides and furs for protection. When the gun came into use he covered himself with a coat of steel mail. This he wore until the increasing penetration of the bullet caused him to be so overburdened with armor that he could not stand or walk under his great load. Then he discarded armor and at once regained his activity and endurance.

Why should not our armored dreadnoughts follow these laws?

On the other hand, there are many officers in the navy who desire to keep everything, armor, gun power, and increase the speed of the dreadnought to that of the battle cruiser. The "Queen Elizabeth" type is an expression of this desire. And still a few, a dwindling minority, desire to increase armor and guns and decrease the speed. They consider even an eighteen-knot battleship a mistake, and would build one of twelve knots speed, giving this tremendous saving in weight to guns and armor. The twenty-one-knot dreadnought of the "New York" type they look upon as a mistake. They would have shorn off at least six or seven knots and placed on it at least two more fourteen-inch turrets and several more inches of armor. To them the battle cruiser is a waste of money.

The result of these conflicting opinions has been a

compromise. It has prevented the battle cruiser from being added to our building program until the present war in Europe demonstrated to even the rankest doubters that such warships were indispensable in a well-balanced fleet.

The improvement in the efficiency of the torpedo and the real menace of the destroyer, armed with these weapons, undoubtedly added weight to the decision for battle cruisers. The line of battle required protection from destroyer attack. An efficient protection was contained in the destruction of enemy destroyers. For this purpose great speed was necessary, also a heavy armament to destroy armored cruisers supporting destroyer attack. The battle cruiser seemed to give the panacea desired. It can be seen then that a battle cruiser can perform many useful services: (*a*) Control communications; (*b*) destroy enemy cruisers; (*c*) destroy enemy destroyers; (*d*) scout in advance of fleet; (*e*) support smaller scouts in getting information of enemy; (*f*) support own destroyers in attack on enemy battle line; (*g*) fight in the line of battle or against enemy battle cruisers.

Modern strategy and tactics have divided the cruiser into several classes: battle cruiser, armored cruiser; protected cruiser, scout cruiser. Of these only the first and last are ultimate types; the protected cruiser and armored cruiser are merely steps toward the battle cruiser.

Beginning with the first armored cruiser, Table IV shows the evolution to the battle cruiser. It has been a persistent advance in gun power and speed and to a lesser extent in armor protection.

While glancing at Tables IV and V, let us consider Mahan's test of a system of naval administration: " It is its capacity, inherent, not spasmodic, to keep the establishment of the navy abreast of the best professional opinion concerning contemporary necessities, both in quality and quantity. It needs not only to know and to have what is best to-day, but to embody an organic provision *for* watching and forecasting to a reasonable future what

TABLE IV.

The Evolution to the Battle Cruiser

Date	Name (Class)	Country	Heaviest Guns	Belt Armor	Max. Speed (knots)	Max. Dis-place-ment
1890	New York...	United States	4–8″	4″	21	8150
1892	Grafton.....	England.....	2–9.2″	5″	19.5	7350
1893	Rossiya.....	Russia......	4–8″	10″	20	12500
1895	Brooklyn....	United States	8–8″	3″	21	9215
1896	Diadem.....	England.....	16–6″	4″	20.5	11000
1897	Fürst Bismarck	Germany....	4–9.4″	8″	19	10700
1898	Asama......	Japan	4–8″	7″	21.5	9750
1899	Sutlej.......	England....	2–9.2″	6″	21	12000
1900	Essex........	England.....	14–6″	4″	23	9800
1901	Maryland...	United States	4–8″	6″	22	13680
1902	Roon.......	Germany....	4–8.2″	4″	21	9050
1903	Washington..	United States	4–10″	5″	22	14500
1904	Achilles.....	England.....	6–9.2″	6″	22.5	13550
1905	Scharnhorst	Germany....	8–8.2″	6″	22.5	11420
	Tsukuba....	Japan	4–12″ 8–8″	7″	20.5	13750
1906	Ibuki.......	Japan	4–12″	7″	22	14600
	Blücher.....	Germany....	12–8.2″	6″	25	15550
	Inflexible....	England.....	8–12″	7″	25	17250
1908	Von der Tann	Germany....	8–11″	10″	25	19400
1909	Moltke......	Germany....	10–11″	11″	27	23000
	Lion........	England.....	8–13.5″	9″	28	26350
1910	Princess Royal	England.....	8–13.5″	9″	28	26350
1911	Seydlitz.....	Germany....	10–11″	11″	26.5	25000
	Kongo......	Japan	8–14″	10″	27	27500
1912	Tiger.......	England.....	8–13.5″	9″	28	27000
1913	Ersatz Hertha	Germany....	8–12″	13″		26600

will be demanded. This may not be trusted to voluntary action or to individual initiative. *There is needed a constituted organ to receive, digest, and then officially to state, in virtue of its recognized office, what the highest instructed professional opinion, the opinion of the sea officers, holds concerning the needs of the navy at the moment and for the future, so far as present progress indicates. There is in the naval administration, as constituted by law, no organized provision to do the evolutionary work,* the

TABLE V

Comparative Armored Cruiser Evolution

Date Laid Down	Name		Gun Power		Maximum Armor		Maximum Speed		Maximum Displacement	
	United States	England	United States	England	United States	England	United States	England	United States	England
1890	New York	Edgar	4– 8″ 35 cal. 10– 5″ 40 cal.	2–9.2″ 30 cal. 10– 6″ 40 cal.	4″	5″	21	19.5	8150	7350
1893	Brooklyn	....	8– 8″ 35 cal. 12– 5″ 40 cal.	....	3″	....	21	....	9215	......
1896	....	Diadem	....	16–6″ 40 cal.	4″	....	20.25	....	....	11000
1899	....	Drake	....	2–9.2″ 45 cal. 16–6″ 45 cal.	....	6″	6	23	....	14100
1900	....	Essex	....	14–6″ 45 cal.	....	4″	....	23	....	9800
1901	Maryland	Cumber-land	4– 8″ 45 cal. 14– 6″ 50 cal.	14–6″ 45 cal.	6″	4″	22	23	13680	9800
1902	Charles-ton	Argyll	14– 6″ 50 cal.	4–7.5″ 45 cal. 6–6″ 45 cal.	4″	6″	21.5	22.25	9700	10850
1903	Washing-ton	Black Prince	4–10″ 40 cal. 16– 6″ 50 cal.	6–9.2″ 45 cal. 10–6″ 50 cal.	5″	6″	22	22.5	14500	13550
1905	Montana	Shannon	4–10″ 40 cal. 16– 6″ 50 cal.	4–9.2″ 50 cal. 10–7.5″ 50 cal.	5″	6″	22	23	14500	14600
1906	....	Invincible	....	8–12″ 45 cal. 16–4″ 45 cal.	....	7″	....	25	....	17250

sifting process, by which in civil life The Rough Fighting Test of Supply and Demand, of competition in open market, and free usage pronounces decisively upon the practical merits of various instruments or methods of manufacture. The body of sea officers, the workmen of the navy, receive for use instruments upon which the system provides them no means of expressing the professional opinion as to their adaptability, relatively, to service conditions or to other existing instruments. Whatever harm may result falls not only upon the workmen, but upon those also for whom the work is done; that is the Nation."

These words of Admiral Mahan, despite all recent reforms, are partly true to-day. The object of the above quotation was not to discuss administration, however, only, in passing, emphasize a result of faulty administration due to incomplete organization for carrying out the nation's affairs.

Tables IV and V show that the United States actually was far ahead of all other nations in the conception and construction of the "New York" in 1890 and the "Brooklyn" in 1893. This must be attributed to a happy accident or a stroke of individual genius. It was not due to "watching and forecasting to a reasonable future," because no more vessels of this type were laid down until 1901—eight long, inactive years.

Even England completely failed to see and follow the true trend of cruiser development; from 1896 to 1901 that nation built "Diadems," "Drakes," and "Cumberlands," with speed to be sure, but with no real gun power.

In 1901 the United States again awoke, and with the construction of the "Maryland" class was ahead of contemporary development—another stroke of individual genius, no doubt. The following year unwise counsel seemed to have prevailed and the United States, discarding her lead, constructed the "Charleston" class, practically duplicating the "Essex" of the "County" class. In 1903 the United States built the "Washington" class.

This see-saw shipbuilding policy possibly may be laid at Congress's door. No doubt Congress gave only so much money and yet stipulated the number to be built. This cannot be done unless the nation is willing to pay the price of defeat in the next naval war.

The evolution from the cruiser to the battle cruiser has acted to increase the number and calibre of guns, to increase enormously the speed, and to keep armor protection at a bare minimum. Tonnage has had to keep pace with these three factors.

The Scout Cruiser

The scout cruiser is a vessel conceived for a special purpose. It is an offshoot from the parent stem of cruisers. Its principal duties appear to be to get contact with enemy battleships or fleet, to ward off an attack of enemy destroyers upon own battleships and mine laying in battle. It is all eyes and no power.

For these duties its most vital characteristics are speed and radius of action, together with seaworthiness. Gun power and protection for this type are merely for defense against a speedier enemy.

Gun power and armor protection have been the levers forcing great tonnage, in consequence the scout cruiser has not grown bigger; in fact, the present development in Europe is a vessel of very moderate displacement, sufficient only for seaworthiness and fuel capacity.

The United States in its latest scout cruiser construction gives greater gun protection than rival nations. The new American scouts are to carry a strong battery of six-inch guns and are to have the phenomenal speed of 35 knots an hour. As a large radius of action is a vital necessity for this type of warship these new scouts will have a displacement of somewhat over 7000 tons. We yet may see scout cruisers armed with one or more large guns in order to re-enforce the battle line after its other duties are completed.

TABLE VI

The Evolution of the Scout Cruiser

DATE LAID DOWN	NAME (CLASS)	COUNTRY	GUNS	SPEED (knots)	DISPLACEMENT
1892	Columbia.	United States	1–8″ 2–6″ 8–4″	22.8	7350
1892	Gefion....	Germany....	10–4–1″	20	3770
1895	Pelorus...	England.....	8–4″	20.5	2135
1896	Chitose...	Japan.......	2–8″ 10–4.7″	22.5	4760
1897	Jurien de La Graviere	France......	8–6.4″	23	5685
1902	Bremen...	Germany....	10–4.1″	23	3250
1903	Sentinel...	England.....	9–4″	25	2895
1905	Salem....	United States	2–5″ 6–3″	24	2756
1907	Boadicea..	England.....	6–4″	25	3300
1908	Augsburg.	Germany....	12–4.1″	25.5	4350
1909	Bristol....	England.....	2–6″ 10–4″	25	4800
1911	Rostock..	Germany....	12–4.1″	28	4900
1912	Arethusa..	England.....	2–6″ 6–4″	30	3520
1913	Carolina..	England.....	2–6″ 8–4″	30	3800

Table VI shows the scout cruiser evolution since 1892. The United States has built no scout cruisers since 1905, when the "Salem" class was built. It will be noted that our "Columbia" class began the development of this type of warship, but the United States again failed to take profit of this achievement.

The United States to-day has not one single modern cruiser for scout duty with the fleet.

An army, on shore, is dependent upon two important "services": (*a*) The service of information; (*b*) the service of security. The reason for an army's dependence upon these services is apparent enough. In order to be able to dispose intelligently of its forces, to march in the right direction, to be ready to meet a sudden attack, to be able to camp or bivouac without fear of surprise, all these demand information of the enemy.

Reconnaissance to find the enemy is usually made by cavalry, aeroplane or dirigible. These three may be formed into a separate or independent brigade or division and pushed out to the front several day marches ahead of the main body of troops. Its duty is to find the enemy's main body and then to preserve contact. To find the enemy's main body it is generally necessary, first, to defeat his cavalry, destroy his aeroplanes and dirigibles. The cavalry is usually kept concentrated ready to strike upon information brought in by aeroplanes, dirigibles or detachments from the concentrated troops.

These soldiers, far in advance of the main army, give it security, which is a most important factor for morale.

In the same way exactly battle cruisers, armored cruisers, scout cruisers and destroyers should operate far in advance of the fleet. Cruisers should carry seaplanes for quick reconnaissance. To find the enemy's fleet it will be necessary generally to defeat his advance force of similar types of vessels. This was the work cut out for Vice-Admiral Beatty in the Jutland battle. If Germany had had no battle cruisers and no scouts the British scouting force need not have engaged. All that would have been necessary was to remain and observe the German main fleet, sending minutely reports to Admiral Jellicoe as to its position, speed and courses steered.

The absence of scouts in our fleet throws us entirely on the defensive.

Above, the service of information only has been discussed. Security is of greater importance. The battle line, composed of battleships, must be protected against both destroyer and submarine attack. This requires cruisers. A battleship force requires advance, flank and rear guards, for the same reason as does an army; to prevent surprise attack, to permit deployment before the full force of an attack develops. These guards for a fleet are called a " screen," and consist of fast cruisers: scouts, armored and battle cruisers. In default of cruisers, the United States fleet must employ destroyers on cruiser

duty; a great hardship upon the destroyer, besides using an important offensive weapon upon a purpose for which it was not intended, and which it is incapable of performing, except for a very limited time, for it has not the size, resisting power, nor the gun power of a cruiser.

In providing a fleet with the service of information and security, a serious situation confronts us. To find an enemy fleet the practice is to "sweep" with a line of cruisers the segments of the sea in which it is thought the enemy ought to be found. Naval strategists took for granted the enemy would employ similar methods to locate our fleet and consequently considered that the two lines of cruisers would come together and a battle of cruisers would be the result. It is then no longer a light or scout cruiser that is needed to drive back the enemy cruisers, but a strong, powerful cruiser. Now, to give to our fleet a "cloud" of cruisers, with a large number of heavy fighting cruisers, has a disagreeable consequence in diminishing the battle line; yet shall we put our cruiser tonnage in battleships and depend upon chance to find the enemy? The solution is a difficult one, but undoubtedly lies toward putting the maximum tonnage into fighting units and only when superiority is assured over all probable enemies using tonnage for other purposes.

"If my heart were opened," wrote Nelson, when he was searching for Brueys' squadron in the Mediterranean, "there would be found written on it 'more frigates.'" "Without doubt he was right," writes Daveluy, in "The Genius of Naval Warfare," "but if the Admiralty had replaced line ships by frigates there could have been read in Nelson's heart 'more fighting ships.'"

By many naval strategists the true solution of the service of security and information for the fleet lies in utilizing only vessels that can lie in the battle line. This reduces scouting to only the area about the fleet. Vessels to be used would be destroyers supported by very fast battleships or very powerfully gunned battle cruisers. This theory decides against scout cruisers unless their use-

fulness in the tactical battle can be proved a valuable one. England and Germany have successfully employed scout cruisers for mine laying and to support their destroyers in an attack upon enemy battle line.

We thus see that the more study we put on the subject the firmer we become convinced that the battle line must not be shorn of gun power. The only solution, therefore, is to sacrifice armor for speed in the types of ships to be used as "eyes."

CHAPTER XIII

WARSHIPS ARMED PRINCIPALLY WITH THE TORPEDO

THE torpedo in recent years, even against pronounced and bitter prejudice, has finally demanded the attention which its wonderful possibilities deserve. When it is considered that nearly every warship carries these weapons, it does not seem at all strange that the eyes of the naval men are turned torpedo-ward and are watching its development with keen interest and admiration.

The torpedo bids fair to influence, in a marked degree, our future naval construction, for even the airship and the sixteen-inch gun cannot give the battle line half as much uneasiness as this terrible fish with a "head" of high explosive.

The types of warship built solely to carry the torpedo are the "destroyer" and the "submarine." The battleship and cruiser are armed with these slim steel weapons, but merely for tactical reasons. The personnels of the big ships furthermore are too much occupied with the powerful gun battery to give more than a passing thought to the use of torpedoes in battle.

The destroyer did not get its name from the fact that it can destroy battleships. The derivation of its name lies in the duty for which it was originally designed: destroy torpedo boats. It was called at first torpedo boat destroyer; afterwards shortened to plain destroyer. The torpedo boat is nearly extinct; at least no more are built.

At the inception of the steam epoch the automobile torpedo began its slow process of development. This development was from the start a steady growth. First, the range of the weapon was scarcely more than a few hundred yards. Not so long ago that we can all remember it was barely 500. In its early stages it was not considered a weapon of accuracy, rather the reverse.

It was thought by many to be more dangerous to friend than foe. The torpedo boat was the next and natural step in its development, for a small vessel was necessary and one having high speed to carry out the supposed visionary aims of the torpedoists—to be able at night to approach within the danger area of the torpedo it carried before the big ship discovered its presence. These small craft of necessity were speedy. They were small because it was necessary to approach very close before the weapons they carried could be used. The visibility range of a searchlight at this time was about 1500 yards, and the torpedo boat's aim was to get as close as possible before being discovered and then its speed would help it to remain under fire a minimum length of time before it brought it to torpedo range.

The torpedo boat first made its appearance as an adjunct to the fleet in 1886. Its displacement at that time was less than 100 tons, and its speed about 20 knots an hour. From this time on it gradually increased in size and speed until in 1896 the torpedo boat displacement was slightly over 125 tons and its speed about 23 knots.

The next evolution was the destroyer. This new type of vessel became necessary, for even at this time the dangerous character of the torpedo boat was recognized; armed as it was with at most an inaccurate weapon. In the war between Chile and Peru in the eighties the possible danger of the torpedo was pointed out, and during the revolution in Chile in the early nineties a battleship fell a victim to a torpedo fired at night from a large torpedo boat. During the Japanese-Chinese war in the middle nineties, torpedo boats were freely used by the Japanese; no results, however, were accomplished worthy of note. Many torpedoes were fired but few, if any, serious hits were made. In our war with Spain the torpedo received a great blow; not because of the fault of the material, but because of the lack of initiative displayed by the Spaniards, and, on our part, by the stringent

orders from the Navy Department to our few torpedo boats to take no unnecessary risks.

In the war between Japan and Russia, fresh in the memory of everyone, much damage was done by the Japanese torpedo craft and much more might have been accomplished if the Japanese had been willing to risk the destruction of their small attackers. At the first part of this war Japan was forced to husband her resources, for there was a second enemy's fleet at home which had to be taken account of. In the final battle, when the second Russian Fleet was destroyed, the water was too rough for the small vessels to accomplish much more than a few brilliant but fruitless dashes at the enemy; some in broad daylight. However, the usefulness, nay the necessity, of the destroyer was clearly demonstrated.

After this war opinion was crystallized upon the subject of the *destroyer*. Naval men fully appreciated the injurious moral effect upon the crews of the big ships which were, as matters stood, at the mercy of a well-timed and planned attack in force by a flotilla of torpedo craft. The salvation of the big ship lay first in the destructive power of its small guns aided by several more or less inefficient searchlights to illuminate the torpedo boat after its discovery; second, in the effectiveness of the torpedo nets carried by many of the ships; and third, in the known inaccuracy and erraticism of the then existing torpedo.

The duty of the *destroyer* was to run down attacking torpedo boats and sink them with the fire of their small rapid-fire guns. The destroyer was also armed with torpedo tubes in order that it might be used as an attacking torpedo vessel; but its main function was to defend the battleship at night.

The naval student at this time was quite sure of the correct destiny of these two types of torpedo vessels. The smaller he classed as a weapon of defense—to guard the home coast from raids by the enemy's major warships. The larger he called an offensive weapon—to destroy the smaller defensive type and allow capital ships to perform

without peril their duties of blockade and similar war measures upon the enemy's hearthstone.

The above definitions are somewhat confusing, and perhaps need a closer explanation. The torpedo boat in being a weapon of defense became in the hands of daring defenders a dangerous weapon of offense. It could issue forth from its hiding places in shallow waters, seek out and attack the enemy's battleships and cruisers. The destroyer, on the other hand, being a weapon of offense, remained with the attacking fleet and in the attacks of torpedo boats on the fleet became a weapon of defense; guarding the helpless capital ships at night from the rushes of their small antagonists.

As the years went by the accuracy and range of the torpedo vastly improved until to-day the latest torpedo is said to carry a distance of five miles at a speed of about thirty knots. The torpedo boat slowly increased its size to make it more seaworthy and habitable; for as the range of the torpedo increased the necessity for diminutive proportions to prevent early discovery lessened. Torpedo boat tonnage rose to about 400 tons and then merged into the destroyer. As the size of the torpedo boat increased, destroyer tonnage was forced to keep pace. The final destroyer displacement or tonnage has been more or less accurately determined by all nations from a consideration of the strategical and tactical duty of the fleet with which it will serve. In our case, it must keep the sea for weeks at a time if it is to accompany the battle fleet. It must therefore be large enough to carry fuel and stores for these long intervals and besides be fairly habitable for its crew. Thus our latest destroyers are of about 1000 tons. Germany, on the other hand, built destroyers of about 650 tons, for numbers were considered of more importance in the restricted waters of the North Sea and Baltic than size.

The "torpedo-boat destroyer" or "destroyer" was originally conceived, as has been stated, to destroy small *torpedo boats.* In design it was similar to its smaller *ancestor, only* faster and with greater gun power and in

consequence of greater size. Being of a more sturdy construction, more weatherly, it finally took the place of the torpedo boat at sea. The attack of the destroyer upon a battleship was thought to be best done at a time when surprise would serve to bring the attacker within the accuracy range of its torpedoes—at night. As the range of the torpedoes increased, the use of destroyers in a day action between battle fleets was considered an important function, more especially during the time when the enemy battle line was under gunfire of the opposing battle line.

The offensive weapon of the destroyer was at first the gun, but after the torpedo boat disappeared the torpedo was recognized to be the important weapon. Guns were retained for defense solely. Its pivotal characteristics were high speed, moderate radius of action, plurality of torpedo tubes and torpedoes and seaworthiness. Increased size was necessary to enhance these pivotal characteristics.

Increased size, on the other hand, lessened the chance of being able to surprise a watchful enemy, and surprise was a corollary in its usefulness. Once discovered, the risk of destruction was great and the difficulty of firing torpedoes to hit greatly increased.

These considerations naturally tended to limit the size. Sufficient tonnage for necessary offensive work being gained, no further increase was believed to be justified. The successful development of the submarine has materially changed some of the hitherto accepted theories of the uses of the destroyer. It has been found very efficient in the duty of destroying submarines on the surface by gunfire and by ramming.

The tendency is therefore to increase the destroyer's gun power for offensive purposes against the submarine. This brings the destroyer back to the original conception of the use of that type. Its further development probably will be towards very high speed, moderate size, long-range

torpedoes, a plurality of small guns and large radius of action.

TABLE VII

The Evolution of the Destroyer

Date Laid Down	Country	Armament		Maximum Speed (knots)	Displacement
		Torpedo Tubes	Guns		
1893	England.....	2	6–6 pdr.	27	290
	England.....	2	6	30	300
From	Germany....	3	3	27	420
1894	England.....	2	4 6 pdr.	25.5	450
to	Germany....	4	2 to	32.5	650
1912	United States	6	5 3″	29.5	742
	England.....	2	6	33	990
	Japan.......	3	7	35	1100
1913	England.....	4	8–4″	35	742
1913	Germany....	5	2–4″	33	850
1913	United States	8	4–4″	29.5	1100

In Table VII, beginning in 1893, the speed, the number of torpedo tubes, and the tonnage displacement of destroyers has steadily increased. Gun power has increased in calibre but not in number of guns. The latest destroyers carry four-inch guns. That the destroyer has become a very nasty customer for the battle line is only too evident. Its work in day action has not netted many torpedo hits, if reports of recent naval battles can be relied upon.

An enemy's battleship fleet vanquished in the battle, its crews in panic and therefore its guns quite harmless, should offer the maximum opportunity for destroyer attack.

An attack in force by destroyers at this stage, especially if supported at not a great distance by a division or so of undefeated battleships, may cause the demoralized ships of an enemy to surrender.

The destroyer commanders must do and dare in a *general chase.* Great tactical results may be expected *with but few* torpedo hits.

The value of the day torpedo (destroyer) attack during an action or during the chase after a successful action is a subject which bears examination from a psychological standpoint.

Colonel Aubier of the French Army in speaking of cavalry, which is the destroyer of the army in its moral effect when attacking, has this to say: " Who is so narrow as to imagine that the rôle and tactical capacity of cavalry is measured by the number of individual deaths that its sabre inflicts?" Cannot we put this for our own use, " Who is so narrow as to imagine that the rôle and tactical capacity of destroyers is measured by the number of individual torpedo hits?"

There are no authentic cases to prove the soundness of this implied truth, but Colonel Aubier gives some interesting cases of the moral effect of cavalry charges.

(*a*) At Marengo five or six hundred troopers of Kellerman routed the long Austrian infantry columns.

(*b*) Eight squadrons of Pulz's Brigade at Custozza forced an army corps to stop several hours in its advance.

(*c*) Bredew's six squadrons at Vionville arrested an attack just begun of an army corps.

Aubier concluded, " Did all of these produce serious losses?" No, but they obtained great tactical results. By such acts they gathered the fruits of long-continued efforts and spared their armies many another sacrifice.

Ballistic factors are neither intangible nor sovereign; the moral factors still preserve and always will preserve a decisive influencc upon the issue of battle.

The destroyer, supported by large cruisers, makes an ideally offensive force, especially if armed with long-range torpedoes. Making contact in the daytime with an enemy's fleet, destroyers at night can slip through the screen and attack the enemy while in its night formation. A fleet subjected to successful torpedo attack during the night preceding a day action will have its morale severely *shaken, which will* enhance the power of its enemy even *if the material* losses have not been great.

A well coördinated destroyer force becomes an important asset to a fleet about to go into battle. A well-timed feint upon the enemy battle line may give to its own battle line an advantage of position which no amount of manœuvring could have gained. By the intelligent use of a " smoke screen," made by emitting vast volumes of oil smoke from destroyers' smoke stacks, a battle line in confusion can be saved from destruction, enabling it in security to re-form or to escape. The German Fleet in the battle of Jutland is said to have been lost sight of in a smoke screen formed by German destroyers just when the main British Fleet thought they had brought a superior force against it. When the smoke cleared the German Fleet had extricated itself from its embarrassment.

The Submarine.

The submarine is the least understood of any of the modern weapons of naval war. While its beginning dates from the end of the eighteenth century, its modern development did not begin until after the torpedo boat had reached its full development and had been supplanted by the destroyer.

The submarine was revived for the day attack upon battleships, the destroyer being considered more efficient as a nighttime weapon. The development of the internal combustion engines and storage batteries, surface and submerged propulsion agencies are directly responsible for the submarine's marvellously rapid evolution.

The modern submarine was conceived, or at least proved, in this country. Two designs were tried, the Lake and the Holland types; each was successful. The United States now builds a proportion of each type.

The main features of all submarines are essentially identical. First there is the pressure hull or spindle, *built to* withstand the pressure of water at a depth vary*ing, dependent* upon the type and size, from 150 to 200 *feet submergence.* Considering water pressure as one-

half pound per square inch for each foot of depth, these pressures range from 75 to 100 pounds per square inch, which the hull must withstand.

The hull is divided usually into a number of watertight compartments; beginning from forward they are generally speaking: (*a*) Torpedo compartment, containing the torpedo tubes and torpedoes; (*b*) forward battery compartment, containing one-half the storage battery; (*c*) the central operating compartment, containing all aids to navigation submerged and the valves, etc., for submerging the vessel; (*d*) the after-battery compartment, containing the other half of the storage battery; (*e*) the engine compartment, containing the Diesel engines for surface propulsion; (*f*) the motor compartment, containing the motors for submerged propulsion; (*g*) the tiller compartment.

The submarine has two systems of propulsion, viz.: (1) Engines for surface running and for charging the storage batteries through the motors driven as dynamos; (2) the storage battery and motors are the motive power submerged.

While a submarine is running on its engines it is navigated just like any surface vessel. The exhaust gases from the heavy oil, internal combustion engine are led overboard through exhaust pipes running through the hull either above or below water.

The vessel has a certain free-board and considerable buoyancy, dependent upon the type.

When the submarine is to submerge, an entirely separate system is called into play. First the boat is sealed up; that is, every opening in the hull is closed tight—hatches, valves, etc. Then water is admitted into the ballast tanks, located at the lowest part of the hull, until these tanks are completely filled with sea water. The boat meanwhile is kept level longitudinally by admitting water into the forward and after trimming tanks. These tanks are at the very ends of the vessel. When the ballast tanks are full of water and the boat is trimmed, that is,

at the desired inclination, either level or a degree down by the head or stern, the submarine is then said to be in the "awash" condition. It has then only about 3 per cent. buoyancy. To further submerge, the diving tank is flooded. This tank holds sufficient water to compensate for the 3 per cent. buoyancy and the submarine loses all buoyancy, or else retains only a few hundred pounds. The vessel is now said to be submerged. The submarine has two rudders, one that steers in the vertical and the other in the horizontal plane. If when nearly in the submerged state the motors are started ahead, by using the horizontal rudders, two pairs, forward and after pair, the submarine can be forced down level to any depth desired.

While submerged, vision is obtained through the periscopes, which are a vertical system of lenses and prisms enabling an observer within the submarine to see around the complete circle of the horizon. In order to see, however, the top lense must be above the surface of the water; once these lenses are submerged then no further vision is possible and the submarine must steer by compass.

To facilitate steering submerged a gyroscopic compass is installed. A magnetic compass is of no value, due to the fact that a submarine running on its batteries and motors becomes a great magnet, its field having vastly greater influence on the needle than the magnetic field of the earth.

The air for breathing is simply that contained in the boat when sealed, and is at atmospheric pressure irrespective of the depth of the boat. Over a hundred cubic feet of air at several thousand pounds pressure is stored in heavy steel containers or flasks. This air can be used for several purposes: ejecting water from ballast and diving tanks, for putting an air pressure in the boat in case of a serious leak and for purposes of renewing air for breathing. The air in a submarine may be renewed by first pumping air overboard and then filling in from air flasks.

The electric storage batteries not only supply the power for under-water propulsion, but provide current for electric auxiliaries, cooking and lighting.

Usually submarines carry one torpedo and one spare torpedo for each torpedo tube.

The storage battery limits the undersea operations of a submarine. It can remain below the surface, if not on bottom, only until the battery is exhausted, then it must rise to the surface to obtain a recharge. This time limit depends upon capacity or endurance of the battery. It should be understood that the faster a submarine travels submerged, the shorter the time it can remain down. For instance, with battery fully charged, at eleven knots speed, after about one hour so much charge has been used that the motors must be slowed to give a speed of about seven knots. This can be maintained only a short time, when again it will be necessary to slow until after another hour or two the motors can no longer be turned over without great danger to the battery. If, however, a moderate speed is used throughout, say of five knots, it is possible to run submerged from eight to ten hours. As a maximum, however, fifty miles may be considered the submerged radius of the average small submarine boat of our navy.

The submarine began with small displacement; however, for offensive work at sea increased tonnage has logically resulted. The great powers at war are now constructing submarines of approximately 800 tons surface displacement. These are engined with two 1400 horsepower Diesel engines driving the vessel on the surface at speeds variously estimated at from sixteen to eighteen knots an hour. In the present development of Diesel engines for submarines greater horsepower is possible only by increasing the number of cylinders on a shaft, which is not good practice, and this would materially detract from the reliability and efficiency of the vessel as a submarine. To gain very high speed, therefore, say more than twenty knots, a new propulsive agency is required or else a more effective development of the Diesel engine. *Steam has* been tried and has failed. With *steam propulsion* the heat developed is insufferable and a

prohibitive time is required to submerge, thereby greatly increasing the danger from armed surface craft.

It is unlikely that submarine tonnage will increase beyond moderate limits. Great size will increase the dangers in operation. In the design of submarines the most important consideration was safety. A safe type has been achieved. After this the characteristics of speeds, surface and submerged, reliability and mobility were solved. Sufficient size was recognized to be a necessity in order to give habitability, seaworthiness and to permit the vessel to carry a plurality of torpedoes. The offensive power of a submarine is measured by the number of torpedoes carried rather than by the number of torpedo tubes. It is probably impossible to fire more than two well-aimed torpedoes at one time. A submarine having fired all its torpedoes is of no military value until it can return to its base for a new outfit of proved ones.

The Control of the Surface and the Submarine.— In the command of the sea, three factors are now involved:

(1) The control of the surface, (2) the control of under the surface, and (3) the control of the air.

The submarine is cetaceous. It can remain submerged a limited time, only until the storage battery, which is the source of power for undersea running, is discharged, then unless the bottom is at a depth well within the pressure test, it must come to the surface to recharge its batteries. If the bottom is within reach the time submerged can be prolonged until air for breathing is exhausted. While on the surface recharging its batteries by means of its engines, the submarine is in constant danger of being destroyed by an enemy surface vessel. The control of the surface gives not only security to your submarines by clearing the seas of enemy surface vessels, but it permits you to use all manner of antisubmarine craft to hunt down submarines of the enemy. It vitalizes your submarines and endangers those of the enemy.

The control of the surface is gained through superior

gun power and speed. The principle involved in the evolution of the warship yet holds—a vessel to permit soldiers to fight at will on the water. To bring an enemy to action superior speed is essential.

The submarine is a " weapon " and can hardly replace the surface ship; at least not for many, many years to come, when its size might become sufficiently great to permit it to fulfil all the functions of a surface craft—an unlikely development.

As a weapon it is extremely dangerous to ships of moderate speed. A battleship of the " New York " type, costing fifteen millions of dollars, might readily fall a victim to a single torpedo fired from a submarine. Fifteen submarines of the largest size yet developed could readily account for a battleship of the " New York " type. The cost of fifteen would be less than the cost of one " New York." The " New York " alone would be unable, against fifteen submarines, to control the surface.

If a nation should build only submarines against one building only surface vessels, the latter by controlling the surface could eventually win the decision by the destruction of all enemy submarines. The former nation, the one having only submarines, would be forced to employ guerilla tactics and the sea being " covered " by enemy guns, mounted upon numerous surface ships, would soon find itself impotent against its enemy.

The Importance of the Submarine to the United States

The submarine should distinctly appeal to those of this country who desire " defense " without giving " offense." The submarine is not an aggressive weapon; its best rôle at present is on the defensive, for its field of operations is limited.

In comparison with other warship types it is less expensive to build, can be built in a shorter time, requires fewer *personnel,* and is cheaper to maintain.

In consideration of its tactics its rôle might be de-

scribed as a projection to a distance of our coast defense; a means of extending our frontiers. A nation with a fleet sufficiently strong to command the seas against any enemy might be said to have no ocean frontiers. Its frontier lies always along the shore of an enemy's country. "He who commands the sea, commands the shore."

With a formidable submarine fleet, supported by sufficient surface warships to contest the command of the sea, the United States would be in a position to prevent the sea power antagonistic to our normal development from controlling the surface within a limited distance of our shores. In effect, we could be able to place between our shores and an enemy's a disputed zone of ocean. The width of this zone will depend, first, upon the strength and efficiency of our surface warships, and, second, upon the radius of action of our submarines.

In the event of war with an enemy across the ocean and that enemy attempts invasion, it becomes the navy's rôle to destroy the expedition before it can arrive on our coast. To perform this duty scientifically and safely, we should be capable of attacking that force as far from our coast line as the strength and effectiveness of our fleet will permit. The distance will be in direct proportion to our effective naval strength.

The width of the zone of ocean between our shores, and where the strength of our fleet permits us to attack an invading enemy, naturally dictates the size of submarines for our navy. Seaworthiness and radius of action each is a function of size. If we are able to dispute a zone 1000 miles deep, then our submarines must be large enough to effectively operate to that distance and safely return.

If the nation gives up all pretension of disputing any zone of ocean, but complacently awaits attack on its coast, then small harbor defense submarines in great numbers will answer. The nation that awaits attack must lose all its commerce and all its outlying possessions. Invasion becomes only a matter of course after the enemy has suc-

cessfully pierced the defensive chain spread lightly over our enormous coast line.

Since the war in Europe guns are mounted on board submarines for defense against patrol vessels or aircraft or offense against merchant vessels.

To increase tonnage for such purposes is a misinterpretation of the principles governing in submarine development. Defense should be sought rather through ability to quickly submerge, efficiency of periscopes, efficiency of sound detectors and ability to manœuvre for long periods submerged.

The submarine threat has drawn full attention to a means of defense against it. For its destruction a new type of warship possibly may be developed, of high speed, less intricate and less expensive than the destroyer, capable of carrying a slow speed aeroplane. Already patrol boats, of from sixty to eight feet long, driven at high speed by internal combustion engines, armed with several small guns, are being used abroad against submarines.

TABLE VIII

The Evolution of the Submarine

Date in Service	Country	Armament		Speed (knots)		Surface Displacement
		Torpedo Tubes	Guns	Surface	Submerged	
1901	United States	1	..	9	7	about 90 tons
1904	England.....	2	..	11.5	7	180
1909	England.....	2	..	14	10	280
1910	England.....	3	..	16	10	550
1912	Germany....	4	1	14	8	650
	United States	4	..	14.5	10.5	390
	England.....	4	1	16	10	725
1913–14	England.....	6	2	18	10	940
	Germany....	4	2	18	10	750
	United States	4	1	14.5	10.5	425
1915	England....	Nothing accurately known.				
	Germany....					
	United States					

The Torpedo.—Torpedoes or explosives moving through the water to the object attacked, as distinguished from the mine or stationary explosive, first took the form of what amounted to a towed mine. The Harvey, Menzing and the French towing torpedoes were weapons of this kind. The torpedo usually consisted of from 30 to 60 pounds of dynamite or other explosive in a metal case which was supported by the necessary float. The torpedo was towed astern of a launch with a rig that permitted a rudder on the torpedo being controlled from the towing boat. The torpedo could be guided to a position on the quarter, while a second torpedo was towed astern. A dipping or detaching apparatus provided that when the whiskers of the torpedo touched the target, the torpedo would be completely submerged before the explosion took place. In order that this early type of torpedo should be successful, great skill on the part of the crew was necessary.

The spar or outrigger torpedo came into active use during the Civil War, and on more than one occasion during that period as well as in later years proved its worth. The weapon consisted of a torpedo carried at the end of a pole or spar which projected from a launch. It was so rigged that just before the target was struck, the torpedo could be plunged below the surface to obtain the plugging or holding effect of the water for the explosion. The explosive usually consisted of about 33 pounds of guncotton which could be fired upon contact, or at will, by the use of a firing battery. To carry and drive home the spar torpedo a fast seaworthy launch or small torpedo boat was developed.

During the Civil War the "Housatonic" was sunk off Charleston, S. C., by a Confederate submarine boat fitted with a spar torpedo. The submarine and its crew were lost. In Hampton Roads the Federal flagship "Minnesota" was seriously injured by a spar torpedo attached to a Confederate steam launch under the command of Captain Davidson. The launch and its crew escaped

uninjured. For the Federals Lieutenant Cushing, in a launch fitted with a Wood and Lay spar torpedo, made a daring and successful attack on the "Albemarle." In this case the launch was forced at full speed over a protecting boom of logs, and was swamped by the water from the explosion of its torpedo. The "Albemarle" was sunk. During the Russo-Turkish War (1877–'78) a very creditable spar torpedo attack took place in the River Danube. Two Turkish monitors, the "Fettu Islam" and "Duba Saife," were attacked at night by four Russian torpedo boats. Two of these, the "Czarovitch," Lieutenant Doubassoff, and the "Xenie," Lieutenant Chestekoff, were discovered when about 150 yards from the "Duba Saife." Though subjected to a hot fire, they dashed in and drove home their torpedoes. The "Duba Saife" was sunk, while the torpedo boats eventually turned up at Brailoff, eight miles down the river.

The automobile torpedo first came into use during the seventies. It was the outcome of a series of experiments commenced in 1864 by Mr. Robert Whitehead, then superintendent of iron works at Fiume, Austria. The capabilities claimed for the Whitehead or fish torpedo, as it was then frequently called, were about as follows:

(1) Could be adjusted to run at any depth from 5 to 15 feet when fired from either a submerged or surface tube, or from surface detaching apparatus.

(2) Upon firing, it would make a straight run, provided that an allowance was made for the deflection due to transverse currents.

(3) It could be adjusted to stop after having run any distance up to its extreme range and after stopping to sink or float.

(4) It could make a run of 1000 yards at a speed of 15 to 16 knots; while 300 yards could be covered at a speed of 19 to 20 knots.

(5) It could carry a warhead containing a charge of 33 pounds of guncotton, to explode upon contact.

This early type of torpedo was propelled by a three-

cylinder Brotherhood engine weighing 35 pounds, which drove two propellers and developed 40 horsepower. The air flask could be charged to a pressure of 1000 pounds per square inch. It was with such a weapon that Mr. Whitehead came to England in 1870; and after the Medway experiments the British Government bought the rights of his invention for 17,500 pounds.

In the United States Mr. John Lay produced a torpedo which the Government took up for experiment. Ammonia was the means of propulsion, and arrangement was made to control the torpedo as to depth and course through the agency of electricity and a paid-out cable. This device did not prove practical. Eventually the Whitehead came to be used in our service, and later the Bliss-Leavitt torpedo was developed.

The Whitehead torpedo made its appearance running under battle conditions during the Russo-Turkish War (1877–'78) at an attack on the Ottoman fleet by Russian torpedo boats, known as the second Batoum affair. One torpedo was fired from the under-water tube of the "Tchesme," while another was launched from a raft towed by the "Sinope." None of the Turkish Fleet were injured, as the torpedoes were badly directed. Later, however, these two torpedo boats sank a revenue steamer by a torpedo fired from a distance of 70 to 90 yards. Torpedo boats at this time were vessels of six to twelve tons displacement, 40 to 60 feet in length, with an engine of about 100 horsepower, and a speed of 15 to 18 knots.

The years gradually developed the torpedo in range, speed and power. The introduction of gyroscopic rudder control improved its accuracy, and when next it was put to the test, in the Russo-Japanese War, it was as an effective weapon of attack. On the night of February 8th to 9th, 1904, Admiral Togo arrived before Port Arthur and immediately struck at his enemy through the medium of the torpedo. Destroyers attacked the unprepared Russian squadron in the outer roads, and placed hors de combat for several months the battleships "Tsarevitch"

and "Retvizan" and the cruiser "Pallada." Under the conditions of the attack, a fine moonless night, and an enemy with but poor lookout, it is surprising the Japanese did not accomplish more. The destroyers that made this attack were vessels of about 350 tons displacement and a speed of 30 knots, and were equipped with 18-inch torpedo tubes.

During the present European war the torpedo has been used right and left with impressive results. It is not possible as yet to discuss the details of the different encounters.

The diameter of the torpedo has increased from 14 to 16 inches to 21 and 22 inches. Its length has reached 21 feet.

A modern automobile torpedo consists, generally speaking, of the following parts: (1) War head; (2) air flask; (3) depth control mechanism; (4) gyroscopic steering gear; (5) engines.

The war head contains the high explosive charge. This is fired by an exploder upon striking the target. The weight of explosive charge ranges from 200 to 500 pounds, depending upon the type of torpedo.

The air flask is a specially constructed shell of steel; very strongly built to withstand a test pressure of 5000 pounds to the square inch. This flask carries air at an initial pressure of 2250 pounds per square inch. An air compressor is used to compress the air to this high pressure. The air is used to operate all the mechanism of the torpedo in addition to the motive power.

The depth control mechanism permits the torpedo to be run at any desired depth under water; it consists principally of a pendulum and a hydrostatic piston actuating horizontal rudders.

The gyroscopic compass through the vertical rudders maintains the torpedo on a course parallel to that in which the torpedo began its run.

The air at the high pressure of 2250 pounds per square inch first passes through a reducing valve which decreases

its pressure to that required for use by the engine. This air then is heated by an alcohol flame, which also acts to produce steam of the water in what is called the combustion flask; the air and steam mix and pass to the engine.

The engines are in certain types reciprocating, but in the latest American torpedo, the Bliss-Leavitt, are turbines driving two propellers.

The tail of the torpedo holds rudders for both horizontal and vertical steering.

The British use the Whitehead torpedoes; the Germans, Schwartzkopf; the French, Whitehead and Schneider; the Japanese and Italians, the Whitehead. In this country, the Whitehead and Bliss-Leavitt torpedoes are in use.

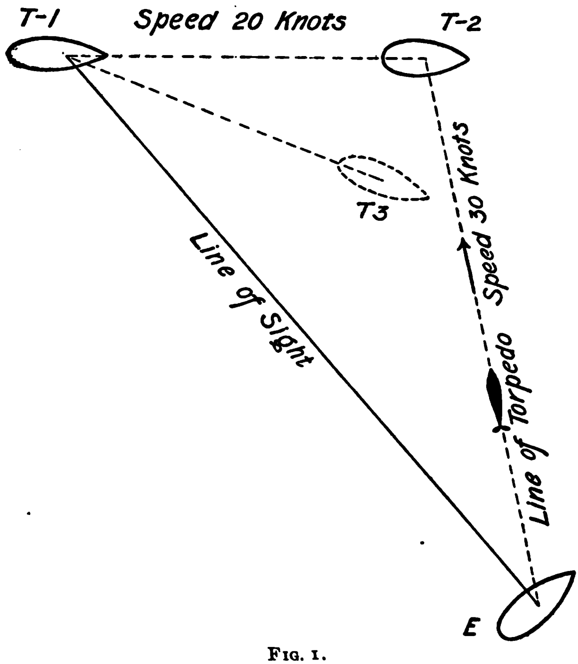

FIG. 1.

The torpedo each year is becoming a weapon of greater range and accuracy.

The United States has its own torpedo factory where an increasing supply of torpedoes is being made yearly. In time of emergency the greatest possible facilities will be required, for no nation should in time of war find itself short of such important weapons. All battleships, cruisers and destroyers carry long range, while the submarines carry a moderate range but high-speed torpedo.

In firing a torpedo at a moving target there exist several factors with which the torpedoist must reckon. They are the speed of the target, the course of the target and the speed of the torpedo itself. In order to make a hit those three factors must be known within limits.

The sketch T-1 (page 164) represents an initial position of a target ship when ship E fires a torpedo. E T-1 is the line of sight. The angle T-1 E T-2 is the deflection given the torpedo to hit after concluding that the target's speed is 20 knots, its course in the direction T-1 T-2, and that the torpedo will run at 30 knots. If the course of the target happened to be T-1 T-3 and not T-1 T-2, then, as shown in the sketch, the torpedo will pass ahead of the target and not make a hit. By similar investigation it can be seen that an error in estimating speed of enemy will cause a miss if error is great, likewise, a miss will occur if torpedo should be erratic in its speed or course.

Therefore, a torpedo cannot be considered a weapon of very great accuracy at long ranges. At very close ranges errors in estimating enemy speed and course, etc., will not have marked effect as at the long ranges. In order to be sure of a hit many more than one torpedo will have to be fired and in consequence a large number of torpedoes should be supplied to each ship so armed.

CHAPTER XIV

THE NAVAL AEROPLANE

By Lieutenant Commander H. C. MUSTIN, U. S. Navy (Naval Aviator)

THE importance of the aeroplane in naval warfare is far from being well understood in this country; the general impression even with many naval officers is that its particular function is scouting; as a matter of fact, its scouting ability is perhaps the least valuable of its assets.

It is also not generally appreciated that if our fleet is inadequately equipped with aeroplanes, it will be at a very serious disadvantage. Consider for the moment one feature alone—spotting gunfire (observation of the fall of shots); a squadron of battle cruisers with guns of 15 (or more) inches calibre, whose fire is controlled by aeroplanes, can defeat an equal or perhaps greater number of dreadnoughts that are without this means of fire control. This statement, which is particularly interesting for the reason that there are no battle cruisers in our navy, will be explained presently; in the meantime I will make some comments on the present status of naval aviation.

Athough the present war in Europe has caused a great advance in the efficiency of the military aeroplane and its tactics, the belligerent powers, so far as we know, have made but little progress with the design of naval aeroplanes and the development of their tactics. The reason for this is that nearly all the air operations have taken place over land or, when over sea, in localities where flight can originate from smooth water. The need for real naval aeroplanes—the types that can operate from floating bases far from smooth water—has therefore not been pressing.

No doubt the necessity for these types is appreciated

by foreign naval officers, especially those detailed for aviation duty, but none apparently has had the time and opportunity to work out the deep sea aviation problems; all the aeronautic resources for design and manufacture on both sides engaged have been worked to full capacity in the effort to prevent the enemy from getting control of the air over land.

In the meantime the small group of naval officers in our service who have been on aviation duty the past two years have worked steadily on the one idea of developing the deep sea requirements in aviation. Something should be said here of the first problem in naval aviation, which is, obviously, getting into the air; the hydro-aeroplane, or aeroplane that starts and finishes its flight on water, cannot get into the air unless the water is considerably smoother than in average conditions on the open sea; as hydro-aeroplanes must attain an air speed on the surface that is equal to its low-flying speed limit before it will have sufficient lift to get into the air under control; this speed, for the various types we require, ranges from 40 to 60 miles per hour. Anyone who has had any experience in speed boats will recognize the futility of attempting to start a flight from the surface of water that is at all rough.

It should be noted that, so far as actual flying is concerned, the air conditions in the open sea are far better than the air over land; it is the inequalities in air, such as gusts, up trends and down trends, that make the operation of an aeroplane tiresome and, to the inexperienced pilot, dangerous. The velocity of the wind means nothing if it is a uniform velocity; a strong, steady gale of wind feels about the same to an aviator as still air. In the open sea the wind comes to us over a surface that is comparatively flat—there are no mountains, hills or valleys, or hot and cold areas to disturb it; the gusts, or changes in velocity, at sea are usually horizontal, and those are comparatively easy to take care of. Consequently, provided we have some satisfactory means of getting into the air at sea, we

can guarantee operation in nearly all kinds of weather; but if our flights must originate from the surface of water, then the naval aeroplane will be only a fair weather apparatus and of little naval value, except in operations near the coast.

The problem in naval aviation of finishing flight is not as difficult as that of getting into the air. The ordinary hydro-aeroplane can be landed in much rougher weather than one would expect; in fact landings without damage can be made in a seaway very much rougher than the limit for getting off. Various plans and devices have been suggested for enabling the aeroplane to return directly to the ship; while it is possible that something on these lines may be worked out in the future for specially designed ships, the schemes are of no value at present; the present difficulties being the motion of the ship due to the waves, and the uncertain air near the ship's deck due to eddies, caused by obstructions on deck. This uncertain air can be felt in an aeroplane two or three hundred feet above a ship even when she is at anchor in a breeze; if under way and steaming into the wind—which is the condition recommended by the advocates of landing on the ship—the air over the quarter-deck would be very bad indeed.

The problem of finishing the flight is, from a military standpoint, of much less importance than the commencement. One can readily conceive that under several conditions in naval warfare there are but two principal events for the air service, commencing the flight and carrying out the mission of the flight; for example, in a gale of wind the torpedo-carrying aeroplanes are launched for an attack on the enemy's battle line or troop ships; after delivery of the torpedo attack the question of what happens to these aeroplanes is interesting but comparatively unimportant.

For work with a fleet three types of aeroplanes are *required:*

Type I. The High-speed Fighting Aeroplane.
Type II. The Medium Speed Torpedo-carrying Aeroplane.
Type III. The Slow-speed Spotting Aeroplane.

These machines must all be suitable for launching from the ship, and capable of being hoisted on board. These and other qualities desired are all well within the designing and manufacturing resources of this country. There follows a brief outline of the characteristics of each of the three types, with some talk on the kind of work each is required to perform.

Type I. The High-speed Fighting Aeroplane.—This is a machine with a maximum speed of about 100 miles per hour carrying a gun for attack on other aeroplanes and, when required, bombs for attack on dirigibles; this machine must be a fast climber; also it must be designed with very little stability so it will be sensitive in its control and thus have the best possible manœuvring qualities. On account of its high speed this machine can have only a small radius of action when carrying two aviators, but on special occasions it can be used as a one-seat machine either to increase its radius of action or to increase its climbing ability.

The chief duties of this machine are: protection of Types II and III (the torpedo carriers and spotting aeroplanes), attack on these two types of enemy machines, and destroying or driving in the enemy's air scouts. Type II aeroplanes, when in condition for a torpedo attack or a bombing expedition, will be so heavily loaded that they will have little defensive power against the enemy's high-speed, fast climbing fighting machines. Type III when engaged in spotting must carry such a large quantity of fuel that reserve lift for armament is not available; besides the control of ship gunfire will keep both occupants of Types III fully engaged in their particular duties: one, the pilot, in keeping station in formation; the other, the observer, in his spotting and communication work, which is a much more complicated matter, in a general engagement, than the uninitiated would expect. As the advan-

tage given by aeroplane control of long-range gunfire is very great, there is no doubt in the future a new and very important feature in naval battle tactics will originate from the questions of protection of our spotters and interference with the enemy's.

Another duty of the fighting aeroplane will be attack on dirigibles, and only a very fast climbing machine can be expected to succeed in this sort of work.

It may be asked here how we can expect success against dirigibles, when aeroplanes abroad thus far have not given a better account of themselves; the principal reason for the poor showing of aeroplanes in dirigible attacks abroad are:

First.—The dirigible bases are within a night's run of the scenes of their operations, so they can, and do, take advantage of the protection afforded by darkness.

Second.—Atmospheric conditions in the North Sea are such that average air conditions for aeroplane flying are bad. This has been explained to me by a neutral aviator who has flown a great deal in that region.

Third.—The percentage of really expert aviators abroad is very small. It is well known that the expansion in all the belligerent air services has been so great that pilots are rushed through their school work and into service after less training time than we know is necessary for his rudimentary flying instruction; furthermore, the source of supply is now very largely from civil life, and pilots from this source are lacking in the military or naval knowledge and experience indispensable in service aviators, if real efficiency is to be expected.

Type II. The Medium-speed Torpedo-carrying Aeroplane.—This is a machine with a maximum speed of about 80 miles per hour, designed primarily to carry a torpedo of the kind now carried on battleships or to carry an equivalent weight (about 1800 pounds) of high explosive bombs. This machine would have only a small *radius of action* when carrying its torpedo or when loaded *to full capacity* with bombs, but without these weights it

can be given an equivalent weight of fuel that will add five or six hours to its cruising radius.

The chief duty of this type is torpedo attack on the enemy's battle fleet or troop ships. Here is a function of the naval aeroplane that not only will deserve a very important consideration in naval battle tactics, but also—if there is an ample number in reserve—will make invasion of this country by sea a very dubious undertaking. The fact must not be lost sight of, as mentioned above, that aeroplanes of this type must have their escort of fighting machines to counteract the enemy's best means of defense, namely—attack by his aircraft.

As a bomb carrier Type II would probably not be used except in attacks on naval bases, particularly those that an oversea enemy would establish within working distance of our home coasts—as likely as not in neutral territory and perhaps before any formal declaration of war. Bomb attacks by aircraft on moving ships in the present state of the art of bomb dropping is not accurate enough to make it an effective means of offense; that is on account of the fact that there is not yet (and probably never will be) a means of determining instantly the course of an aircraft relative to any object on the surface; also no instrument can tell the directions and velocities of the various air currents below an aircraft at a high altitude. However, we will not lose sight of the fact that there are possibilities, under favorable conditions, in a swift, low altitude attack with bombs on ships under way; for example, when swooping down in misty weather or from low-lying clouds the aeroplane would be visible to the ship's lookouts and anti-aircraft gun pointers only a few seconds before the pilot had come so close to his target that he could not very well miss; but the pilot's chance of escape from effects of his own bomb under such circumstances would be remote.

Type II when carrying extra fuel instead of its torpedo *or bombs will* be used for scouting. In this condition it

will have to be armed for protection upon possible contact with the enemy's fighting types.

Type III. The Slow-speed Spotting Machine.—This is a machine with a maximum speed of about 60 miles per hour. The chief duty of this type is spotting for control of gunfire, and this is the reason for its long endurance and the consequent slow speed; it will have to take the air early in the manœuvres preceding an engagement and perhaps wait several hours before firing commences.

Now to explain the statement in the first part of this paper relative to an engagement between battle cruisers and dreadnoughts. It should be noted that as firing ranges increase the difficulty in observing the fall of shots, even from the highest point available aboard ship, increases; finally, when the great ranges that are possible with guns of 15-inch calibre and over are used, the point of impact of the projectiles is invisible to the spotters of the firing ships. At long-range firing it is absolutely necessary to control fire by spotting; this on account of the following two reasons: (1) The naval range finder is inaccurate at great ranges. (2) Even when the exact distance of the target is known there are always disagreements in the sight bar ranges and actual ranges that must be corrected by spotting observations; the greater the range the greater are these disagreements.

If the battle cruiser with its long-range guns keeps at a distance outside the limits of spotting from the ship, it will be hit only by chance shots from an opponent without aeroplanes. The battle cruiser with its advantage in speed can choose the range for an engagement with the slower dreadnoughts; consequently if its fire is controlled from an aeroplane, it can make a reasonable percentage of hits—very efficient on account of the plunging effect at long ranges—while being nearly immune from the fire of the dreadnought without aeroplanes.

When ships are matched in speed and gun power, *those that* have aeroplane fire control have a very positive

advantage over those that control from the tops; it is well known that the one who makes hits first with the very destructive projectiles of this day will at once have a big lead in the engagement.

Another duty of the Type II machine will be patrol of the fleet when cruising in war time. This type, on account of its slow speed, is not suitable for scouting runs of any great length; but it can establish a patrol of the main body of the fleet during all of daylight, outside the limits of torpedo range—keeping a lookout for submarines that may evade the outer screens, and also looking for floating mines. On this duty some of these aeroplanes would carry bombs for attack on submarines; others would carry guns for the same purpose.

It should be said here that, although aeroplanes or any other types of aircraft are not a certain protection against submarines, they are far better than any other means now in existence for protection of ships under way.

It is hoped that the preceding remarks on the uses of the various types of naval aeroplanes will throw some light on the following important considerations:

First.—Unless, in war time, we have sufficient aeroplanes of the fighting type in commission we may as well have none of any type in the fleet. The torpedo carriers and spotting machines, if not well protected, will not last long enough to be of any use against an enemy well equipped with fighting machines. Control of the air must be the ultimate end in view.

Second.—We can never develop a comprehensive and efficient system of naval aeroplane tactics unless we have material and personnel sufficient to permit working in large groups with the fleet. All these problems must be worked out in peace time and the personnel thoroughly drilled, especially in the coördinating features of their work; on account of the high speeds and comparatively great number of units dealt with in naval aviation, there is no branch of service work where thorough coördination is so vital to success.

Third.—The art of flying is a comparatively insignificant part of the attainments a naval aviator must have; the man in command of a naval aeroplane must not only be an expert flier, but also must be well versed in the subject of naval aeroplane tactics, as well as being a seaman and navigator. He also must have sufficient knowledge of the other naval equipment and tactics to be sure of knowing what it is he sees in order that he may avoid disastrous mistakes, such as incorrect scouting information or attacks on our own ships.

The best source of supply for naval aviators is obviously the line of the navy; with ample flying school and practice flying facilities these officers can be qualified in about three months; but if we must draw our aviators from other sources, such as civil life or from enlisted personnel, it is quite evident a much longer time for complete training will be required—the period will be a matter of years instead of months. The idea is frequently expressed that all we need in an aeroplane is an aviator, something on the order of a chauffeur in a motor car or a quartermaster aboard ship, who will take care of the manipulation of the controls, while a naval officer not an aviator will act as navigator and observer and command the aeroplane. It would be just as reasonable to say that we can put individuals in command of our ships who are not capable of handling them, simply because the commanding officer of the ship does not actually take the wheel under way. If, for example, a torpedo boat has a speed of 80 to 100 miles per hour and had to be steered up and down, as well as right and left, and at the same time be maintained right side up by their rudders, is it likely that the commanding officer would con her while in close formation by word of mouth to a helmsman? Decidedly not; he would be at the controls himself. On the other hand, on long flights not in close formation the aviator in command of an aeroplane could safely turn over the controls to a relief aviator, who need not be qualified in much else but the handling of the machine

and care of its details; to this end we are now training enlisted men of the navy for the rating of aeroplane quartermaster, but for each of these we must always have at least one fully qualified aviator for command of the aeroplane. In time some of these enlisted men might work up to full qualifications as naval aviators, just as some enlisted men have worked up to commissions in the line of the navy and eventually to command of ships.

CHAPTER XV

THE AIRSHIP

The value of the airship for naval purposes is undoubtedly great. They have been used most effectively by the navies during the present war in scouting work, locating mine fields, discovering the presence of submarines and communicating their information to their own vessels either by signal or by radio.

It is said that the following plan is used to locate airships: Each airship has a chart divided up on the map-square system. There are located ashore a number of radio-locating stations; these stations are plotted on the map-square chart of the airship. An airship desiring to plot itself makes a prearranged signal with radio, repeating at definite intervals of time. Two stations take bearings of these radio waves and send the bearing immediately to the airship. The airship records these bearings and the navigator lays them off on his map-square chart; their intersection gives the position at the time stated of the airship. The squares on the map-square chart being numbered, the airship records its position within a certain square. All scouting reports by airships are preceded by the airship's position in a certain square.

For instance, the airship makes its signal by radio to be plotted, repeating every minute for a certain number of seconds. Two stations simultaneously, at a prearranged time arranged by the airship, take bearings of the airship's radio waves. Then each station in turn sends by radio time and bearing. Times of course must be the same. Suppose these bearings were:

Station No. 3, time 10:06 A.M., bearing 65 degrees.
Station No. 2, time 10:06 A.M., bearing 75 degrees.

And again suppose that at 10:28 similar bearings *were taken of the* airship from two stations:

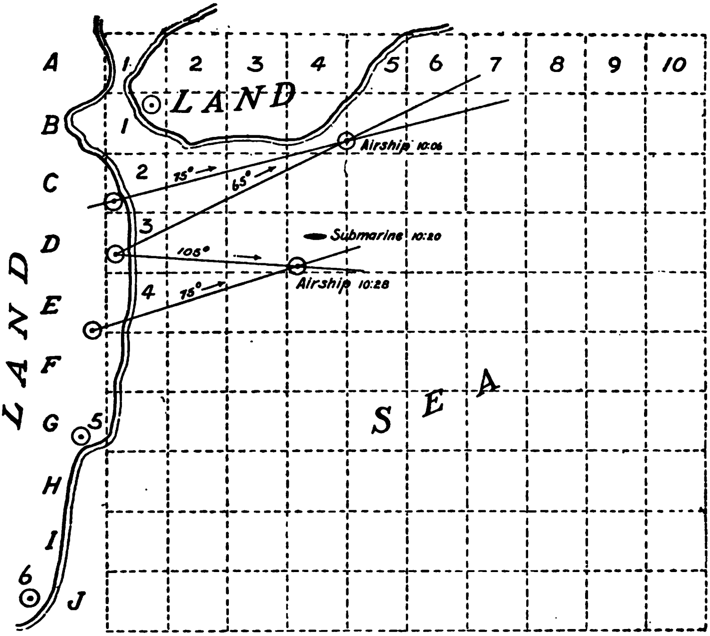

FIG. 2.

Station No. 3, 10:28 A.M., bearing 105 degrees.
Station No. 4, 10:28 A.M., bearing 75 degrees.

In the diagram above at 10:06 the airship plots in square B-4 and at 10:28 in D-4.

At 10:20 the airship observed a submarine under it. It reports submarine in D-4 at once. All naval vessels having these map-square charts will at once know where submarine has been observed.

It is reported that this is similar to a method used by German Zeppelins in reporting scouting observations to the High Sea Fleet.

The Zeppelins are remarkable scouts. In a few hours they can explore an immense horizon and inform their surface warships by radio regarding everything for miles around.

A fleet covered by a sufficiently large flotilla of such

airships can navigate with a practical certainty of avoiding surprise from a superior force.

To lift a weight in the air requires either heating the rarefied air or else the use of hydrogen gas. This gas is highly inflammable. Heated air was discarded on account of the great amount of fuel required to heat the air. In spite of its inflammable character hydrogen gas was used.

The gas cells were first made of gummed cotton. The structure of the Zeppelin was made of aluminum. The principle involved was to combine lightness of weight with extraordinary rigidity and strength. The shipbuilding art was employed in the design of aircraft, but when one realizes that air gives only the one-thousandth part of the lifting force of water, it will be seen that its application was of but little practical value.

The small buoyancy in air necessitated great bulk for the airship in order to raise its own weight, the fuel for flight, water for ballast, the machinery, lines and anchor gear, and the necessary crew.

The first Zeppelin had a gas volume of 11,300 cubic metres.

The covering of the frame consisted of a layer of waterproofed cotton outer and silk inner; the latter was used to obtain a light construction. The first propelling motor experimented with was only nine horsepower. Four-bladed propellers were employed, diameter about 45 inches. The Zeppelin's maximum diameter first was about 12 metres, or about 39 feet, and its length about 426 feet. The weight of the machinery and driving gear and the cabins was divided into two parts: one hung under the centre of buoyancy of the forward part and one under the centre of buoyancy of the after part.

The cross-section was a polygon of 24 sides, built as an open framework, consisting of longitudinal and transverse frames. The transverse frames divided the envelope into 17 compartments for gas. Aluminum was the material of construction of framing.

Corresponding to the number of compartments there were 17 gas cells of gummed cotton.

Side steering was accomplished by steering planes at each end. Steering in altitude was by means of an elevating rudder at the forward end. Between the first and second sections as well as between the third and fourth sections along its length were hung rigidly secured pontoons, each containing a 14.7-horsepower Daimler motor. By means of double bevel pinions of cast aluminum and bevel shafting and rawhide gears each motor drove two right and two left turning propellers situated at the height of the centre of resistance.

Having built the first Zeppelin and proved its capabilities, in order to improve its lifting power and make it an efficient aircraft for passenger carrying or war purposes, it became necessary to develop more powerful machinery and richer fuel in order to accommodate a greater number of crew and passengers, room for living, wireless apparatus, anchor gear, etc., and for war, to carry guns, ammunition and bombs.

There was no lighter gas than hydrogen that could be used. It seemed impossible to decrease the weight of the material of construction, while the weight of the gas cells continually had to be increased to give strength and durability. Finally a proper method of handling gold-beater's skin for gas cells was discovered and the weight of the gas cells was reduced considerably.

Carrying capacity, in other words buoyancy, was accomplished by increasing the size of the gas space and by the economical use of aluminum in the framing.

Lightness of construction was accomplished through introduction of triangular girders in place of flat girders, and in using pressed and stamped forms. In the main, the greatest gain in lifting force, which was brought about by an increase in volume, was due to the resulting increase in speed. This achievement was due to the wonderful strides made in motor development caused by the popularity of the automobile. The shape gradually was

changed, having ends more pointed to decrease resistance.

The latest Zeppelins have the following dimensions:

Diameter, 14–20 metres; about 47–67 feet.
Length, 149–210 metres; about 497–750 feet.
Contents, 20,800–32,000 cubic metres.
Horsepower of engines, 1000–4000.
Speed, 50–70 miles per hour.
From 4 to 8 engines used.

The 24-side polygon has been changed to one of seventeen sides and the former blunt nose has been lengthened to 28 metres and the after point to 32 metres.

The airship has one great advantage over the aeroplane in long-sustained flights, especially over sea. The aeroplane requires a machinery installation which must have the power necessary for the flight desired and must use that power continuously during the flight, else it will fall. On the other hand, the airship need not continuously use its power; it can rise and float similarly to a balloon.

Any mishap to the aeroplane—a stalled engine, a fractured propeller blade—necessitates immediate landing. An airship, on the contrary, can remain afloat and effect repairs.

Every well-balanced fleet should include a flotilla of airships.

CHAPTER XVI

THE NAVAL MINE

THE mine is a recognized valuable weapon of naval warfare. Its use in the present war has been extensive. To date of writing, November 1, 1916, the following have been the mine casualties among the belligerents:

WARSHIPS SUNK BY MINES

Country	Number	Tonnage
British	13	66,670
French	2	1,050
Russian	1	300
Japanese	2	250
Italian	2	6,500
German	2	9,550
Austrian	6	4,000
Turkish	2	4,050
	30	92,370

The United States has two mining branches; one is under the Coast Artillery and is used as an element in the fixed defenses of our coast. The army mine fields are laid to place an obstacle in the path of an enemy raiding force or to keep an enemy fleet outside of certain important areas. These mine fields are covered by guns in fixed positions. The other branch is under the navy and it has only recently been developed and now forms a part of the active fleet.

The control of the fixed mine defense naturally belongs with the control of the fortifications.

The control of the fixed land defenses and mine fields logically should belong to the navy in order to insure complete coöperation between the mobile and fixed defenses of the coast. This control by the navy becomes all the more evident when it is realized that the fleet will use these fortified positions freely in war and to guarantee the safety of the fleet in port and its base during the

absence of the fleet has been the primary demand for fortifications. Furthermore, the fleet for its own safety, as well as due to its better understanding of naval matters, should dictate the location of mine fields. Abroad the navy controls the coast fortifications and the fixed mine fields.

Naval mining may be logically divided as follows: (*a*) Coastal mining, denying to an enemy suitable ports, undefended or practically so; (*b*) advance base mining; (*c*) off-shore mining—strategical; (*d*) battle mining—during an engagement between fleets—tactical.

The effectiveness of mines is primarily due to their being obstructions. Whenever their presence is known or even suspected, that area is avoided as would be rocks or shoals. The purpose of mining being to obstruct, all other means of obstruction should be classed together and given over to the same personnel to operate.

Coastal mining, outside of areas defended by the guns of coast fortifications, does not require large vessels or speedy vessels. Tugs, trawlers and light draught fishing vessels, with naval reserve crews, could be used to advantage for this service. These vessels should be provided with both searchlights and light guns in order that they may guard their own mine fields. The control of this force should be under the mining force of the navy and in time of peace trained under the direction of the naval mining branch.

Advance base mining is the logical duty of the active naval force. For this purpose an organized unit should be supplied, consisting of several mine ships, a mine depot ship, about six seagoing tugs, and two net layers. The mining ships should be armed with guns sufficient in number and power to defeat an attempt of an equal number of raiding cruisers from interfering with the progress of the work establishing the advance base ashore and the laying of mines for protection of the harbor. Mining ships are provided with facilities to lay and pick up mine fields. The tugs are used for sweeping areas to be used

by our fleet in manœuvres or to sweep a channel to insure that no hostile mines have been planted. The sweeps are made of wire hawsers and chain; they are hung between two tugs and the bight of the sweep is dragged across the area to be swept. When the sweep fouls a mine it drags it from its moorings and explodes it. The net layers are for the purpose of laying submarine entangling nets across the entrance of a harbor or about a fleet anchored in an open roadstead.

In mining the channels of an advanced base, mines are laid in the principal channels and are usually distantly controlled. That is, they are exploded by observers ashore, when an enemy ship is near enough to be endangered.

Off-shore mining or strategical mining is done for the purpose of denying certain waters to an enemy. Sufficient mines are laid to make a venture by an enemy fleet extremely hazardous. The very idea that mines are in a certain locality, yet the exact position being indefinite, will cause an enemy to shun the place in the same manner as a navigator shuns localities on the chart where foul ground is reported but not accurately located. For this mining, mine-laying vessels of considerable size are required, to be accompanied by a mine depot ship and tugs. The vessels for this duty should have good speed. It may be necessary to steam to the locality to be mined in swift vessels in order to arrive before an enemy can anticipate the attempt and thwart it.

High speed can be given mining vessels only by sacrificing mine capacity. When occasion demands very high speed scout cruisers should be used or even destroyers. Their mine capacity being limited, numbers only can successfully negotiate extensive mining operations.

In strategical mining a supporting force must accompany the mine force to protect it from interference by enemy fast cruisers which may, due to their speed, arrive

even before the mining expedition or at least before the mining has been entirely completed.

It is quite axiomatic that all naval mining should be directed by a single officer. Those who place mines or other obstructions know best their location, character and possibility of their recovery. The mine force in their training become expert in locating and recovering the material they lay. Therefore, the clearing of an area of enemy obstructions is the work of the mine force as well as the laying of mines and obstructions. Hostile obstructions must be guarded against continuously; the mine force through their experience know best how to undertake this guard duty and are fitted with adequate material for the work.

Battle mining, during an engagement between fleets, can only be accomplished by vessels of very high speed. Some nations build ships primarily for this duty, their characteristics being on the order of scout cruisers, but with decks to carry several hundred mines. The mines are laid in such localities during the course of the battle that may be in the line of advance or retreat of the enemy. Once having mined an area, it is the aim of the fleet to force the enemy over the mine field. Mines used in battle are either fixed or floating. When off soundings, floating mines only can be used. They can also be laid by destroyers. Great care must be taken to keep clear of waters mined by vessels of our own fleet.

The mine is a necessary weapon for our fleet. We should develop its usefulness to the maximum and place the control of mining operations under one head.

Submarine Nets.—The submarine has proved itself such a menace to ships at anchor in open roadsteads and even in harbors closed, except for a narrow entrance, that some means of thwarting these attacks has been sought and found in the use of submarine nets.

The nets used in the European war are both anchored *and floating.*

The working of the net is quite simple. The sub-

marine, while submerged, cannot see obstacles placed in its path. It runs its bow into the net spread for it and becomes hopelessly entangled. It must come to the surface to clear the net and then watching patrol vessels will dispatch it with gunfire. It may find that the net has so fouled it that to come to the surface is impossible and will then have to remain caught and its crew slowly suffocate.

A net used in Europe is made of ½-inch to ⅝-inch in diameter wire rope, mesh 12 feet by 12 feet. This is large enough to allow the submarine to get its bow into the mesh but not large enough to allow of it to push through the mesh.

The net is made in lengths of about 1000 to 1500 yards, and its depth 12 fathoms, or 72 feet. Heavy anchors moor the two ends of this long net, while at each 15 or 20 fathoms additional anchors are attached by chain to the bottom of the net. At the top of the net buoys are attached every 10 to 15 fathoms to keep the net vertically stretched.

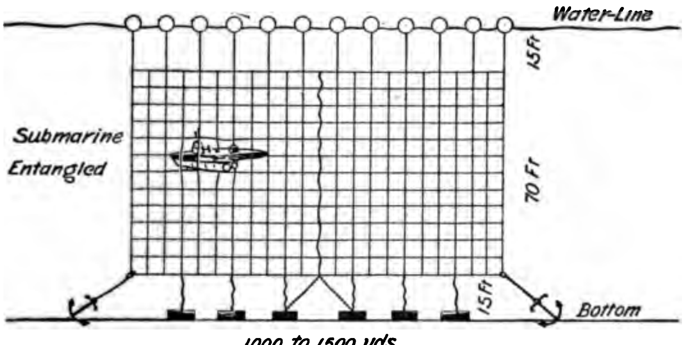

FIG. 3.

Where the steel wire ropes cross to form the mesh clamps secure the ropes together. The net is very flexible and when a submarine becomes foul the net is very liable to foul propellers and get caught in the projections on the deck of the submarine, hopelessly entangling it.

As a defense against nets, it is said that submarines carry oxygen-acetylene outfits and, after waiting until nightfall, blow out all their ballast, lifting the entangling net to the surface, and then cut the wire ropes of the net, thus freeing themselves. However, if the net is caught only in the bow, if the submarine should blow its tanks, its bow would be so weighted down that the tail would float to the surface, thereby up-ending the vessel in a most dangerous and probably fatal manner. Submarines have been known to have disentangled themselves from nets after hours of diligent work through a lucky chance

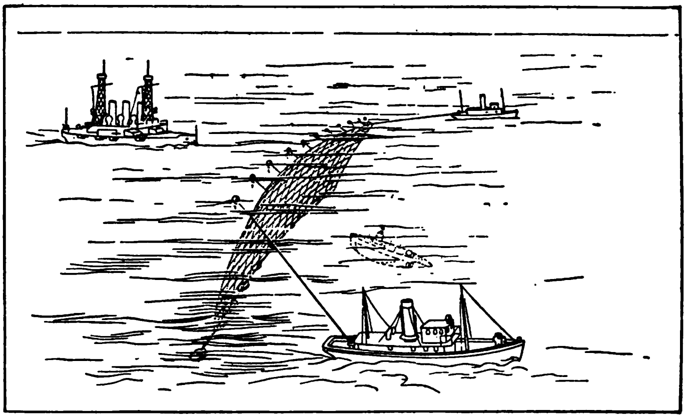

FIG. 4.

and not by using any safe and workable method. It is believed that a submarine well caught is practically helpless, provided the net is guarded by armed patrol vessels.

The floating net is of the same construction, only instead of being anchored it is weighted so as to hang vertically and is towed at slow speed by two tugs or similar vessels. The submarine, if it has used its periscope, observes the two tugs, but is unaware that a net is stretched between them. Attempting to pass between the tugs submerged, it fouls the net and is caught.

Laying the Net.—The net is laid from a specially arranged vessel called a "net layer." This vessel can

carry miles and miles of net ready for laying; the anchors and buoys all attached and at the proper distance apart. The difference between the anchored and towing net is, that in the former the anchors are heavy enough to reach the bottom, dragging the net to the proper depth while the buoys have sufficient buoyancy to hold the net vertical, while in the latter the buoys are sufficiently buoyant to buoy the anchors and net; the anchors in this case hold the net vertical while the two tugs tow the net very slowly through the water.

In the sketch (Fig. 4) there is shown a towing net, while beyond is a vessel toward which the submarine is directing its course of attack. The net is about a mile long, which cannot be shown accurately in such a sketch.

CHAPTER XVII

A MERCANTILE MARINE

A STUDY of a situation and the logical development of the strategy of a war with a country overseas demonstrates how uncompromisingly all operations depend upon the procurement of merchant shipping to cope with the ever-present questions of equipment, supply and communications. No strategic study is possible until it is definitely known, or can be assumed, what means are provided to initiate the war and how complete the arrangements are to transfer the fleets and flotillas to the area of operations and then to support them there adequately against the assumed power and dispositions of the enemy. If the means are lacking to insure the arrival of the full naval strength of a country in the area where the decisive battles of the war must be fought, and to keep it adequately supplied in that area, it is as overpowering a national calamity as a decided inferiority in the quality of the personnel, or in the number and character of the fighting ships.

The vital questions of equipment, supply and communications, grouped by military students under the term *logistics,* enter so largely into the decisions as to routes to be followed by fleets, and the lines of communication which must be protected, that these must be exhaustively studied in time of peace by a corps of trained students.

The United States has an inadequate deep sea merchant marine for commercial purposes and shows no determination to acquire one within the near future. Our navigation laws, the scarcity of American seamen, the high comparative cost of building merchant ships in the United States, the inexperience of Americans for competing with the merchant marines of England, Ger-

many, Norway, Sweden and Japan, all mitigate against our acquiring a sizable mercantile marine at any time.

Many students have declared that government subsidy alone can give the United States the ships required to free us from paying tribute to the foreign mercantile marines. That this condition for a great manufacturing and exporting country is bad enough cannot be gainsaid, but when we consider that the condition also influences our security as a nation, then there is sufficient cause for more than concern.

In case of war with a nation oversea, in the Pacific or Atlantic, the United States Navy would demand, for purposes of supplying fuel to the fleet, coal and oil, about three-quarters of the total tonnage of the colliers and oilers under our flag in the two oceans. And, at a time when our industries must be kept going at more than their usual rate, to provide the military and naval forces with material and supplies which have not been provided and stored away in times of peace.

The navy in time of peace depends for its equipment, supply and communications upon its own auxiliaries, government owned and manned ships, and upon chartered vessels when necessary. This normal peace demand is only a small fractional part of what the war demand would be.

To be in a position to meet this condition, and further to be able to know what resources may be counted upon in order to calculate the fundamentals upon which our naval strategy can be built, the Navy Department, in recent years, has caused this subject to be thoroughly investigated.

It is not well to project vital operations in war that depend for their success upon supply sources that are not under complete government control; and, obviously, foreign sources of supply are included in this category; but the danger of relying upon such sources increases materially *with a limitation* upon the number of such sources. *Therefore the supply* of both fuel and fuel carriers under

the direct control of the government should be developed to the utmost; and then to supplement this supply, and as a means of safety, the supply that can be developed from foreign sources should be utilized to the utmost.

A plan has been developed abroad whereby all merchant vessels that may be required for military purposes are inspected and listed. The plan is somewhat as follows:

(*a*) Each merchant vessel is inspected by a naval board and the following general points determined: (1) tonnage capacity; (2) speed; (3) dimensions; (4) best use in war; (5) crew required; (6) guns capable of carrying; (7) time to convert for war purposes.

(*b*) These vessels are then incorporated into the war plans and the Admiralty issues the required orders as to conversion. In the more advanced military countries the material for conversion is gotten ready and fitted; all that is then required is a few days in a dock-yard to put the material in place.

In this way a government can provide for its military and naval forces and at the same time know how much merchant tonnage will be available for the continuance of peaceful traffic overseas.

The United States Government is fully aware that its mercantile marine is inadequate to prosecute a war on the seas and continue to supply the growing demands of our industrial plants. It will be necessary to take over, by charter or purchase, before hostilities begin, foreign shipping to supplement the United States merchant tonnage.

We can further count on vessels under foreign flags to supply our industrial demands. This, however, is not at all good business for a progressive exporting nation and places it under additional heavy expenses at a time when its expenses will be monstrously large.

Bearing upon the subject of a foreign coal supply *for the fleet,* Oppenheim states substantially as follows:

"*The Foreign* Enlistment Act of August 9, 1870, of

Great Britain, among other provisions, specifically prohibits the building, equipping and dispatching of vessels for employment in the naval or military service of either belligerent, assuming Great Britain neutral. According to Section 30, the interpretation clause of the act, 'equipping' includes 'the furnishing of a ship with any tackle, apparel, furniture, provisions, arms, munitions or stores, or any other thing which is used in or about a ship for the purpose of fitting or adapting her for the sea or for naval service.' It is, therefore, not lawful for British ships, in case Great Britain is neutral, to supply a belligerent fleet *direct* with coal, a point which became of interest during the Russo-Japanese War. German steamers laden with coal followed the Russian fleet on its journey to the Far East, and British shipowners were prevented from doing the same by the Foreign Enlistment Act. And it was in application of this act that the British Government ordered, in 1904, the detention of the German steamer 'Captain W. Menzel,' which took coal at Cardiff for the purpose of conveying it to the Russian Fleet *en route* to the Far East."

Oppenheim further stated: "It may be specially observed that the British Foreign Enlistment Act goes beyond the requirements of International Law in so far as it tries to prohibit and penalizes a number of acts which, according to the present rules of International Law, a neutral state is not required to prohibit or penalize. Thus, for instance, a neutral state need not prohibit its private subjects from enlisting in the service of a belligerent; from supplying coal, provisions, arms and ammunition direct to a belligerent fleet, provided such fleet is not within or just outside the territorial waters of the neutral concerned"—"for Article 7 of Convention VII, as well as Convention XIII of the Second Peace Conference, *categorically* enacts that a 'neutral power is *not bound to prevent* the export or transit, on behalf of *either belligerent,* of arms, munitions of war, or in gen-

eral of anything which could be of use to an army or fleet.' "

However, " If a belligerent fleet is cruising outside the maritime belt of a neutral, the latter must prevent vessels of his subjects from bringing coal, arms, ammunition and provisions to the fleet, for otherwise he would allow the belligerent to make use of neutral resources for naval operations. But he need not prevent vessels of his subjects from bringing coal, arms, ammunition to belligerent ports, although the supply is destined for the navy and army of the belligerent. He need not prevent belligerent merchantmen from coming into his ports and carrying arms and the like, bought from his subjects, over to the ports of their home state. And he need not prevent vessels of his subjects from following a belligerent fleet and supplying it *en route* with coal, ammunition and the like, provided such supply does not take place in the neutral maritime belt."

In further elucidation of the subject of coal and coal carriers, T. E. Holland states:

" ' Coal,' says Lord Lansdowne, ' when destined for warlike as opposed to industrial uses, is contraband of war.' ' When destined,' says Japan, ' for the enemy's army or navy, or in such cases where, *being goods arriving at enemy's territory,* there is reason to believe they are intended for use of enemy's army or navy.' Words italicized mean what was doubtless more clearly expressed in the Japanese proclamation of 1894: ' Either the enemy's fleet at sea or a hostile port used exclusively or mainly for naval or military equipment.' "

"A neutral state distrains, under certain circumstances, the export of coal, not because coal is contraband, but because such export is converting the neutral territory into a base for belligerent operations. The question of contraband, or no contraband, only arises between the *neutral carrier* and the belligerent when the latter claims to be entitled to interfere with the trade of the former."

So far as British traders in coal are concerned, " A

British trader may, therefore, at his own proper risk, dispatch as many thousand tons of coal as he chooses, just as he may dispatch any quantity of rifles or bayonets to Vladivostok or to Nagasaki. It by no means follows that British shipowners *may charter* their vessels for such purposes as following the Russian fleet with coal supplies. Lord Lansdowne's letter to Messrs. Woods, Taylor and Brown is explicit to the effect that such conduct is not permissible. . . . The unlawfulness of chartering British vessels for the purpose above mentioned is wholly unconnected with the doctrine of contraband, but is a consequence of International Law, which is incumbent on every neutral state, of seeing that its territory is not made a base of belligerent operations. The question was thoroughly threshed out as long ago as 1870, when Mr. Gladstone said in the House of Commons that the Government had adopted the opinion of the law officers, 'That if colliers are chartered for the purpose of following the fleet of a belligerent and supplying it with coal, to enable it to pursue its hostile operations, such colliers would, to all practical purposes, become store ships to the fleet, and would be liable, if within reach, to the operation of the English law under the (old) Foreign Enlistment Act.'"

Supplementing United States merchant tonnage by purchases abroad in case of threatened war is not against the precepts of International Law, or its practice in the past. Only in the case of Great Britain is it necessary to make such purchases before war is actually declared. The traders of all nations may ship coal to belligerents, the risk being simply that due to contraband in transit. The laws of Great Britain prevent the delivery of coal to an enemy's fleet at sea; but there is no restriction upon other neutral nations, except in the case of the supply of a fleet lying within or close to the maritime belt of the neutral, when unneutral service, or the use of territory as a base, might be charged. Great Britain does object to her territory being used as a base for supplies in war to

either belligerent; and if we do not enjoy British sympathy, the question of a coal supply from Great Britain or her colonies may be difficult.

A nation that lives by the sea, as does Great Britain, requires a large mercantile marine.

Maritime commerce is said to be the cause and justification of a navy. This, as we have pointed out, needs elucidation, for it may be stated in other ways and be equally true. In fact, the existence of a navy is cause and a justification for a mercantile marine. The two are interdependent. Undoubtedly a mercantile marine or maritime commerce gave the initial need for a navy to protect it. Once having a navy, in order to use it effectively, there is need of a mercantile marine to cope with the ever-present questions of equipment, supply and communications. This is truer to-day than ever, due to the great demands made by a navy upon fuel supply, provisions, material for repairs, etc.

So vital has Great Britain considered her mercantile marine that for centuries she considered its protection the most important act in war. This act is called the Control of Communications. By controlling these, Great Britain remained secure in her commerce, while the enemy's commerce was driven off the seas.

Commerce destroying is a means to an end, but not the end itself. If we consider two belligerents at war, each by means of fast cruisers, destroying the merchant vessels of the other, what benefit will be gained? Each nation may be reduced by several hundred, even thousand, merchant ships, but meanwhile military and naval operations by one belligerent against the other may cause it to sue for peace even after nearly driving the victor's commerce from the seas.

The end must be the command of the sea. This includes the means to be employed to accomplish the end. *The only safe way is by the destruction of the enemy's fighting ships—its fleet.*

A nation with a great navy must maintain a great

merchant fleet. In peace, this merchant fleet must find profitable employment. In war, the navy will draw upon this fleet so heavily that neutrals will be given an opportunity to take part in a carrying trade which was denied them in peace. At the end of the war the merchant fleet will be liberated to return to its pursuits of peace, and will expect the neutral to give up what it has gained. If the neutral refuses and competes with the former holder of the carrying trade, then a trade war results. The nation with a great navy cannot see its merchant fleet idle. It must make it a duty to see it profitably employed in order that it will increase and multiply in numbers, types and tonnage.

Therefore we must see that to curtail the carrying trade of a great naval power is a blow at the very foundation of the navy; its sustenance in war.

Upon the termination of the present war, the entire mercantile marine of the powers at war will again be in the market for cargoes. These vessels will include those now interned, owned by citizens of the Central Powers, and those used for military purposes by the Entente Allies. Competition will be severe. So important is a mercantile marine to such nations—sea powers, such as Great Britain, Germany, Japan—that large subsidies will be given by those governments in order that their merchant marine can win sufficient carrying trade to continue in operation. Those nations, therefore, who permit private capital only to share the loss consequent upon low freight rates due to this violent competition will see their merchant marine gradually disappear, the vessels sold and transferred to other flags.

Let us consider our need of a mercantile marine exclusively from the side of industrial prosperity.

All nations are shown by history to have gone through three stages of development.

The first stage consists of the time when the people are *clearing the land,* building homes and raising food for *their own sustenance.* This is the agricultural period.

The second stage begins when the question of a living is assured and the people turn to industrial life to increase their comforts.

The third stage is the commercial one—where a nation desires to increase its efficiency and wealth by the sale of the products of the nation, which cannot be used by its own people.

The United States has passed from the industrial to the commercial stage, but many of our national legislators have not yet recognized the fact. The country can produce enough in four months to last the home market a year. Shall we run our industrial plants then at reduced speed, or shall we find markets outside of our frontiers and run our plants at top speed, thus giving labor continuous employment and decreasing the overhead cost of manufacture, permitting the articles to compete in price with similar articles manufactured in other countries?

In order to sell the products of manufacture it is imperative for a nation to *control* the carriage of the products from the plant to the foreign consumer. The United States cannot do this without an adequate mercantile marine. With the mercantile marine and with the interest of our citizens assured, sufficiently to invest their money, then sixty per cent. of our industrial products will find a foreign market. Behind our mercantile marine and our commerce must stand an adequate and war-worthy fleet to insure fair competition.

It seems almost a waste of words to show further our need of a mercantile marine. The country now knows the need. If the country had listened to our naval students it could have known it a decade or more ago. The point now is how to get the mercantile marine required. Many plans have been advanced. Unfortunately some are mixed with political aims of the party in power or out of power. The final plan will probably be a compromise. The country will get some benefit, but not all that it should. These compromises on inter-

national issues are more than bad; but under a democracy where there exist many internal interests at variance with *the* interests of the nation, and without a strong centralized power to force the best plan, compromises must be accepted.

All the great military nations—England, Japan, Germany, etc.—pay subsidies to their mercantile lines, in that way insuring the investment against loss. The principle involved is that of "nurserying" a growing infant industry. This "nurserying" is required until the industry becomes strong enough to take care of itself.

CHAPTER XVIII

THE FLEET IN BATTLE ON THE HIGH SEAS

First of all let us consider what the fleet should be and for what it is to be used.

A nation's foreign policy and the means of carrying it out must harmonize. This is axiomatic. Translating this into plain language, it means that the decisions as to the naval force needed for national security, the types of the units composing this force, the location of bases of supply and refit from which the force can be supported in its operations, require previous knowledge of what naval strategists term the "constants," the fixed factors of the international situation.

Merely because Great Britain has fifty dreadnoughts, it does not conclude that the United States must have as many; nor that Germany has thirty should we require a like number.

Mahan warns us against purely algebraic calculations of fleet strength—we must appreciate the international conditions in our naval plans. Could a European nation at war with the United States bring the total weight of its fleet upon our own on this side of the Atlantic? How far would her relations with other European nations allow her to do this?

John Adams and Gouverneur Morris both insisted if the United States had built ships of the line instead of frigates, that England could not have afforded going to war in 1812. Not that we could have built and maintained a navy as large or as powerful as that which ruled the sea, but, considering the international conditions in Europe, Great Britain could not have with safety embarked across the Atlantic a fleet large enough to secure a free landing of her invading troops.

So much for number and types—now as to their use.

The United States sea frontiers extend from Maine to Porto Rico, to Panama, to the Philippine Islands, to

Guam, to Hawaii, to Alaska. What a vast frontier to defend! It can be defended in but one way—by the command of the sea. The command of the sea can be won by the superior fleet, superior in both morale and matériel.

The use of the navy in war is included in the war plan. This war plan must be definite. It must exist in peace and form the fundamental base from which are derived the military characteristics of our warships; that is, speed, radius of action, armament and size.

From the broadest point of view the defense of our sea frontiers involves the elements of defense in the following order: The fleet, including all offensive types of warships, the defensive vessels and mine service, the fixed fortifications, and the mobile field army.

In the conduct of naval war accurate, timely information of enemy naval forces is an important consideration.

An efficient secret service or spy system in both neutral and enemy territory should be organized in time of peace and be in efficient operation upon the outbreak of war. This service will be capable of collecting information of enemy naval forces, transport and troops, which will guide us in our initial dispositions.

For our battle line, comprising the gun power of our massed battleship force, we must have cruisers for both scouting and screening. The battle line must be protected from surprise attack by the enemy battle line, guarded by night from destroyer attack, and by day from submarine attack.

As the fleet moves along, the cruisers must keep clear an area about the fleet, wide enough to permit the personnel in the battle line to feel comparatively secure from those dangerous surprises so apt to shake the morale and lessen the offensive effectiveness of the fleet.

Let us imagine our enemy fleet, somewhat superior in numbers of types, yet hampered with a "train" of auxiliaries and troop ships, approaching our frontier for the *purpose of seizing* forcibly an advance base from which *to carry on war* against us.

Let us suppose also that our fleet comprises a due proportion of types which are actually missing; that is to say, battle cruisers and scout cruisers.

Again, we must suppose that our war plans call for offensive operations against the enemy armada, and that our total effective naval strength will be ready upon the outbreak of war, or at least as soon as the enemy fleet can move away from his home base of supplies.

Our Secret Service will, by radio or cable, inform the Government of the progress of enemy mobilization; when the enemy fleet sails word will be flashed across the sea. After it has been swallowed up in the ocean waste, no further word will be likely, unless a radio from a passing neutral vessel that has by chance sighted the fleet without having its own presence discovered. The enemy will carefully screen his fleet, battle line and train, by a cordon of fast scouts, who will keep out of the screened area all vessels of whatever nationality. Information from neutral vessels of encounters between them and cruisers of the enemy may be received; but this information will be fragmentary, unreliable and in most part negative in regard to the position of the enemy's massed strength and the direction of its approach.

As our defending fleet cannot depend upon being able to meet the enemy on or near our coast without information of his movements as long ahead of his arrival as possible, there comes the need of "scouting."

The enemy, appreciating that secrecy of movement is an important ally, "screens" his fleet.

Here are two words which must be defined:

Scouting.—Operations by a naval force to obtain information of the enemy:

Beginning from the vicinity of the enemy, our scout vessels first *search* for him. That is, by spacing scouting vessels at intervals apart on a line, the line is moved across an area of ocean in which the enemy is believed to be. After the enemy's fleet has been located within a definite area, the next step is called *strategical scouting*. By

this scouting the enemy is followed as it advances.

When our fleet arrives within striking distance of the enemy's fleet, the scouting performed by our scouts is termed *tactical scouting.*

"Strategical scouting" information permits our fleet to place itself in a position to intercept the enemy fleet.

"Tactical scouting" information permits our fleet to dispose its units in order to give battle in an advantageous formation and with an advantageous tactical position.

There are several methods of "*screening.*"

If the enemy should advance his scouting force as far as practicable ahead of his fleet in order to meet and destroy enemy scouts, this is called "*distant*" or "*offensive screening.*"

If the enemy holds his scouting force near his fleet, with the object of maintaining a wall of secrecy about it, this is "*near*" or "*defensive screening.*"

In the case under consideration, we shall suppose the enemy uses the method of holding his screening force near his fleet. This he would do if he were hampered with a numerous and very annoying "train" of auxiliary vessels and troopships, and was restricted in the number of available scouts.

Further, suppose our scouting force was fairly numerous and powerful, which our strategical situation actually demands. The scout cruisers would form a scouting line backed by battle cruisers, and search an area in which the enemy is believed to be. When a scout cruiser meets an enemy cruiser, the latter, performing the duty of screening, will desire to give battle to prevent our scout from getting behind him and discovering the fleet. At this point of "contact" there may rage a battle in which several scouts and battle cruisers on each side will take part. The victor will either push through the screening force and obtain information sought of location of enemy fleet and train, its strength in numbers, type and direction in which it is moving, or else push back the scouting force and conceal the location of the advancing fleet

Our fleet, meanwhile, also screened with whatever cruisers and destroyers that may be available after the scouting force has been dispatched, acting upon information *received* from its scouts by radio, manœuvres to place itself as near the probable path of the enemy fleet as possible.

As the two fleets approach nearer, the scouting and screening may become more desperate. The enemy, if sufficiently strong, may send out a scouting force to endeavor to locate our fleet, in order that he may harass it and cause it to withdraw its scouting force for defense.

If the scouts of both fleets locate their enemy, then night destroyer attacks will be made.

The fleet with a train will endeavor to place itself in such a position as to cover the train from attack of enemy. It will leave, with its train, a guard of warships, their number and power depending upon the margin of superiority over its enemy.

The actual battle between the two battle lines may be expected, if the precedent of history can be safely followed, to begin with a long range duel; first with battle cruiser, as happened in the recent Jutland engagement, and afterwards battle line against battle line, the battle cruisers leading their battle lines and protecting its head from destroyer attack. Destroyers, supported by scout cruisers, armored cruisers and even battle cruisers, will dash in against the head of their enemy's column after it is under the gunfire of the opposing battle line.

From now on each force will, without orders and frequently without signal, carry out a prearranged tactical battle plan, the part each type is to play having been carefully studied and rehearsed during the long years of peace before the war began.

Napoleon has said victory goes to him with the biggest battalions. Other things being equal, this is true, but on *the sea* victory goes to him who has, through long years *of patient study* and practice, prepared himself to ***win the victory.***

CHAPTER XIX

THE FLEET IN BATTLE WITH LAND FORCES

It may be laid down as a fundamental principle that warships, especially those that will lie in the battle line and those that are needed for many services, leading up to and in the battle between the contending fleets, will not be risked against shore batteries before the hostile power on the seas has been completely broken.

So well equipped are modern land fortifications that a frontal attack by warships is believed by most naval powers to be suicidal. The most popular method of reducing seaport forts is to land an army and take them from the rear.

History undoubtedly offers many examples of fleets attacking land forces. Frequently, during our Civil War, this method was successfully used, without disastrous results to the warships. At that time, however, the development of modern ordnance favored the ships. The range of guns was short. The warships could approach so close to the forts that sighting was not difficult, and the ships carried a vaster number of cannon that could be mounted in the forts. The ships actually smothered the forts by their rapid and well-directed fire. The effect was a moral one and caused the fort's fire to so slacken that after several hours of bombardment the casualties among the ships was negligible. However, no lasting results were ever accomplished by these bombardments unless the fleet was accompanied by troops to storm the forts after the guns had been reduced to silence.

In the war with Spain, the United States Fleet several times engaged in battle with land forces. At San Juan, Admiral Sampson engaged the Spanish batteries. The result was nothing. At Santiago, likewise, the fleet bombarded *several times* without benefit. In all bombard-

ments the shore batteries were silenced but not destroyed and the next day were ready again for service.

Togo bombarded Port Arthur several times at long range.

These attacks by a fleet upon seacoast forts must be considered merely a safety valve for the gunners of the warships. The admirals desired to prove their sailors under fire and were willing to accept some slight risk of damage to that end.

A modern example of the futility of warships against seacoast fortifications was the failure of the Allies fleet against the forts at the entrance to the Dardanelles.

The modern seacoast fortification has more than guns to aid in repelling an attack by a fleet. First of all there are the coast submarines operating from a harbor and fully capable, if sufficiently numerous, to keep the enemy fleet outside of gun range of the port.

Inside of this defense are mine fields. These are of two kinds, controlled and contact. They are laid within the range of the fort guns and a fleet, in attacking coast forts from the sea, must run the risk of striking these mines. It is intended that a fleet, before attacking coast forts, will send in its auxiliary vessels to sweep certain areas clear of mines, in order that the fleet may be brought into action in waters safe of enemy mine fields. This sweeping will be under the fire of fort guns and is extremely hazardous work.

Seacoast forts are located at important harbors along a nation's shore line. The object of these forts is: (*a*) to provide security to the city from bombardment of enemy warships; (*b*) to provide security to the merchant shipping, docks, etc., from bombardment; (*c*) to deny an advantageous landing place to enemy troops; (*d*) to provide a safe base to our fleet, or a part thereof, for rest or refit.

Seacoast fortifications, located at an important sea-*port, give a permanent* security which cannot be offered *by naval defense*. In the absence of the naval ships, a

seaport undefended by land guns might suffer serious injury by a raiding force of enemy cruisers. When defended, the fleet may leave with confidence that the seacoast forts will provide ample security and will provide the same security to the fleet upon its return.

After an enemy's fleet has been destroyed an investment of a fortified port by the fleet might be necessary to force the enemy to sue for peace. In this case more risks can be taken, yet the warships are so vastly more vulnerable than forts that other means than direct attack should be employed.

In the taking of Port Arthur, which had for its object the capture of the Russian squadron and the land garrison, the Japanese invested the port by sea and stormed it by land. The Japanese squadron remained at a secure base some seventy miles from Port Arthur, maintaining a watch on the port by destroyers and gunboats.

The United States used similar tactics at Santiago against the Spanish squadron and garrison. In this case the American naval forces remained at the harbor mouth.

The improvement in the mine and torpedo between 1898 and 1904 made necessary the change in the procedure of blockade. Warships at the entrance of Port Arthur were in constant danger from mines laid by the Russians.

England blockades the German coast from a distance of several hundreds of miles. A generation ago this blockade could have been maintained close to the German ports.

The modern coast fortifications may be said to be invulnerable by direct attack from the sea. A fleet might in a fog manage to run by forts guarding entrances to harbors. Once inside, however, but few of our coast guns could be trained upon the invader. The hazard of an enterprise of this kind is so great that it is unlikely to be taken except by a nation with a greatly superior fleet and for a prize well worth the risk involved. To enter one of our harbors in a dense fog with all aids to navigation removed would be difficult even for the experi

enced, yet it can be done and should be considered as a method against which to be prepared.

Coast Defenses.—The fundamental reason for coast defense is for the protection of "bridge heads" from which mobile naval forces can operate. Unfortunately this nation has lost sight of the reason and has defended ports of practically no value to the fleet and in so much neglecting the more important localities.

In war the first line of defense for the nation is an offensive weapon, the fleet, composed of all types of surface warships. This fleet will have behind it the entire resources of the nation and well-prepared ports in which to refuel and refit. The second line will be local coast defenses, mine defenses, and the third, the coast fortifications.

If our fleet is swept from the seas and our local defenses and mine defenses are in the enemy hands, then the enemy's next attempt will be a landing on our shore. This may take place near any one of our great ports. The fourth line of defense is our mobile army. This army must be held in readiness to resist the landing of enemy troops.

Our fortified ports will not be attacked directly—the most scientific method is by attack from the rear. If our mobile army is repulsed, the enemy will mount heavy siege howitzers and destroy the guns and emplacements of our coast forts, then will carry them by assault. Once the fortifications are in their possession the harbor will be available for the use of their fleet and the city for occupation by their army.

Coast forts, protecting an important base for the fleet, must have their guns of sufficient range to hold off an enemy fleet at a safe distance. Our fleet must be able to steam out of the harbor singly and form for battle still beyond the range of enemy guns. This requires *very great range* land ordnance.

The submarine is coming to be considered a weapon *of great offensive* possibilities. As its size, speed and

underwater endurance increased, navies are considering more and more its offensive rôle in warfare. However, the United States has built, and is still building, submarines essentially defensive. These vessels will be useful to protect the land fortifications to a considerable distance from our coast, probably a day's run, and will maintain a narrow zone comparatively free of enemy vessels.

PART III

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Chapter XXI.—The Naval War College.
Chapter XXII.—Organization of the Navy Department for the Administration of the Navy.
Chapter XXIII.—Organization and Distribution of Navy Yards, Naval Stations, and Submarine Bases.
Chapter XXIV.—The Organization of a Warship.
Chapter XXV.—Training of a Warship for Battle.
Chapter XXVI.—The Training of the Fleet for War.

CHAPTER XX

THE WAR PORTFOLIO AND THE WORK OF A NAVAL GENERAL STAFF

A WAR portfolio contains an exhaustive study of a possible war. These studies are abstract studies of policy, enemy forces and our own forces. Every possible condition must be examined and a project for all our forces outlined.

The army and navy cannot each have a separate and distinct war portfolio. The two instruments of war are interdependent. These two services must work in harmonious coöperation not only in planning but in executing.

It must be remembered that war is an instrument of policy; it is a political act and has a political object.

There are therefore three factors to be considered in the war portfolio: (1) Studies of policy, (2) studies of *enemy* military and naval power, (3) studies of *our* military and naval power. In the beginning, then, three professions must come together in research, study and council—statesmen, soldiers and sailors. From this council will be born a complete analysis of the situation confronting the nation in the event of war with a particular country. Upon this analysis and " estimate of the situation " will flow a decision as to the proposed project; the character of the war; forces to be employed, when and where; strategic objectives; extent of coöperation between army and navy, and in fact a complete and exhaustive explanation of the campaign to be undertaken and the resources at our disposal. Pre-war steps, furthering the project of the war portfolio, constitute military and naval preparation.

This part of the war portfolio having been completed, a joint letter of instructions is sent by the President to both War and Navy Departments.

These two departments then exhaustively study their instructions. They estimate their situation and decide the manner of carrying out their instructions from higher authority.

Both the army and navy prepare plans for prosecuting the war; not a collection of isolated acts, but a continuous plan detailing the use of forces; their organization, mobilization, supply and the bases to be used. These plans cannot cover the entire war, for they are based upon an assumption of a passive enemy. The enemy's operations when once war begins will materially affect our future plans; therefore a war plan usually takes us only to the first shock of conflict.

If we are victorious, the plan may give the next step; but as the plans must be made without knowing the enemy's intentions, it is dangerous to project it too far into the future.

A war portfolio being a complete study of conditions, naturally considers all resources which will be at the service of the nation. It plans therefore the organization of these resources in order to bend them to effective use. It should be so complete that no item will have been overlooked.

It will be recognized by every business man that the preparation of such a war portfolio must be intrusted to a specialized and continuous body of men. There can be no snap-judgment tolerated in the preparation of plans for war. This body of men must be numerous; many separate and distinct specialties must be represented, and above all there must be thorough organization for the work.

The preparation of a naval war portfolio is the duty to be entrusted to a naval general staff. Once completed, the portfolio cannot be laid away to be drawn out upon the outbreak of war. Even one day may change the entire foundation upon which the portfolio is based. A change of a policy, an alliance between several possible enemies. *the development* of a new instrument of warfare may

cause the project to be unsound and the war portfolio futile.

There must or should be three separate plan-making bodies: first, the joint plan-makers, then the Army General Staff and the Navy General Staff.

There exists a human weakness, understood by the students of military history, which causes failure when a plan made by others is given to a military or naval leader to execute. In the preparation of a war portfolio a vast amount of study is involved. To give the results of the study to a body of men or to an individual without all the correlated facts and assumptions used in arriving at decisions, without providing them or him with some one to interpret these facts and assumptions, leads to disagreement with and disloyalty to the plan. Not having made the plan, they do not thoroughly grasp its purpose nor the principles upon which it has been founded.

This is the reason why the general staffs should have representatives in the joint plan-making body, and each subordinate leader on land and sea should have detailed with him a member of the general staff.

In a large commercial corporation, if the organization has failed to realize profits, the usual step, before sinking more money in the business, is to study the old organization; to discover if by chance that is at fault. Frequently such investigation discloses dishonesty, incompetency or faulty administration, but more often the framework or medium by which successful results are sought is found to be unscientific and therefore wasteful. The correct remedy naturally enough follows, for money is a powerful lever—scientific organization is the result.

In the years past, never has the navy as a unit attempted conscientiously to persuade Congress to reorganize the naval establishment on modern scientific principles. All attempts have been individual; the results, when any occurred, were piecemeal, aiming to cover up the fault most glaring rather than to achieve anything complete or permanent.

Under our form of government a civilian finds himself at the head of a great technical administration, of whose intricacies he can know but little, even after four years in office. He finds the statutes give him unlimited authority to control the navy and place upon his shoulders the entire responsibility. This authority and responsibility causes him to endeavor to master the subject. He thereupon finds himself attempting to decide minor technical matters. He obtains advice from many men, many of whom accept no responsibility for giving it. If this civilian came to office, finding there a well-organized and efficient naval general staff through which to work, he could reserve his mental force for the things which actually should pertain to his office and permit the navy to be controlled by military "estimates of the situation," made with thorough knowledge of the subjects under consideration from which would naturally and logically flow an appropriate and well-directed military decision.

Without a naval general staff, for as a nation we lack confidence in "staff," the vast majority of Navy Department actions are of necessity based upon inadequate information and lack complete "staff" advice. Here is one of the most evident faults in a democratic form of government; the majority rules while individual staff advice is frequently discarded.

Every large manufacturing company maintains large and expensive "staffs." They have found it is money well invested. The foundation of staff is technical education. In a general staff intrusted with the making of and executing a war portfolio with its war plans, every naval specialty must have its place and its numbers depend upon the work to be performed. The smaller the staff the less research work possible and therefore the less effective will be our preparations for war.

The many vexing questions of personnel and material are always plainly in evidence in peace as well as in war. It is claimed by some that a general staff would not have enough work in time of peace to justify its existence.

But let us remember that on the battlefield nothing can be reaped that has not been sown. In these days a battle which may be decisive immediately follows the concentration of armies, and a fleet action may take place within a week after the declaration of war. Therefore, the crop to be reaped must be sown during peace. The crop is victory and the way must be prepared by scientific research and organization. To this end the general staff in peace must have a separate existence from the routing staff and must of necessity have the first place in importance.

The routine and supply staff are represented by the bureaus of the Navy Department. They supply the matériel and personnel to the fleets and naval bases, and they must in this duty give full loyalty to the plan of the general staff. Victory is made possible only through the representatives of both personnel and matériel subordinating their aims to those of this directing body. In our navy there has never been full coördination between the supply staff and those who have performed incompletely the duties of a general staff, and without such coördination a military organization becomes at war with itself. Therefore, the advent of a foreign war finds the military forces unprepared to strike a decisive blow.

We must give precedence to the general staff, for to them belongs the conduct of war. This is fundamental. If, as may occur, the functions of matériel are to be performed by a non-military branch, even by civilians, we must adhere to the principle of retaining the requisite authority of the general staff over the vital functions of preparation for war. This means the complete subordination of the *means* to the *end,* a natural enough necessity.

The general staff must be composed of officers thoroughly familiar with all the functions of the non-military branches.

Neglecting the duties of a general staff was at the *root of our unscientific* beginning in the war of 1861 and *the war of 1898.* There can be no success in war withou

planning before the war. No plan can succeed unless the means at hand are shown to permit the plan. The wishing and being able must be in harmony. The duties of a general staff embrace every art and science in the conduct of war. The study of the art of war shows that although there exists several fundamental principles which must not be violated, yet much of it is deeply involved in those arts which cannot be freely grasped by the mind unless prepared by long and hard study. There seems to be nothing definitely certain or fixed; very few mathematic or scientific rules to follow to obtain success, and those rules which can be grasped are all in that branch of the art called logistics. In logistics, or another name for the supply of troops in the field or ships on the ocean, the student again steps on firm ground.

A great English writer has said, "Sending forth an army is like sending forth a city, transporting it with all its means of food and shelter from place to place at uncertain times and in uncertain directions, and leaving it all the time dependent on the territory from which it set forth." The navy is in a similar position. It remains dependent on the territory from which it set forth and its supply must be carefully planned beforehand.

Our fleet, in case of war, operating in the Caribbean, would consume many thousands of tons of coal and oil each month. This must be supplied from the home territory. To supply the amount needed would require about one hundred colliers, but from where will these colliers come?

Furthermore, in regard to fuel, we should know from which mine the coal is to be taken because it must be the best obtainable. We must work out the routes and provide safe convoy to this precious supply from our home territory. This is merely a small part of the duties of a general staff. If our supplies fail, then our military plan *must fail.*

Logistics, it has been repeatedly proved, influences the *conduct of a naval* campaign. A strategical plan which

is founded upon a false or purely speculative logistic plan is no plan at all.

All students of war have been impressed with the necessity of an offensive plan. To assume the offensive on the breaking out of hostilities should be the foundation of every properly conceived plan of campaign; but if the logistic plans show that such an undertaking is impossible, it will become necessary to change the plan to harmonize with the logistic requirement. "Material is soulless," ships must have coal, oil and supplies; men must be fed. There can be no naval fighting unless the logistic possibilities are realized. Men have been known to starve and yet fight and again advance to battle, but history has been silent upon the act of a warship, without coal and oil, or without ammunition, doing such heroic acts of devotion to duty.

Is the nation wise to trust these things to haphazard solutions?. Cannot it see that success in the next war will hinge upon the preparations made in time of peace? Questions of naval policy have arisen in the past, are arising every day to be answered. Has the navy been ready with solutions reached through assiduous study in the art of war, and fortified with strategic studies of the possible war areas for which the logistic plans have been calculated and duly satisfied?

CHAPTER XXI

THE NAVAL WAR COLLEGE

FROM the beginning of the navy, our officers had thought in single ships. Even during the Civil War when many warships were collected and joined under a single head, the naval officer still considered his own ship everything, the squadron or fleet little or nothing. When warships were assembled in fleets it was for a specific duty. The plans for this service were admirably studied by those on the spot and the adopted scheme ably executed. From these isolated studies, however, no system of strategy and tactics was evolved. No real coördination nor unity existed except in so far as the plan for the occasion definitely outlined. During the Civil War we had an assemblage of vessels to administer, not a fleet in the present accepted definition of the term.

The administration of our assemblage of ships by the Navy Department during the Civil War was admirable, but there it stopped. The Navy Department did not contain any " formal provision for the proper consideration and expert decision of strictly military questions, from the point of view of military or naval experience and professional understanding." The Secretary of the Navy could not rely upon organized professional assistance to advise him as to the best method of procedure.

It is not enough merely to gather together officers and call this collective body a general staff. The term means much more than that. The officers must be educated and trained coördinately for their tasks. Admiral Mahan has said: " It is evident that the constitution of a general staff, or of any similar body called into being for such purpose, will be more broadly based, and sounder, as *knowledge of the* subject in question is more widely distributed among the officers of the service; and that such

knowledge will be imparted most certainly by the creation of an institution for the systematic study of military operations, by land or sea, applying the experiences of history to contemporary conditions, and to the particular theatres of possible war in which the nation may be interested."

The object of the Naval War College is to pursue such studies as Admiral Mahan describes. It was established during Secretary Chandler's tenure of office. Rear Admiral Stephen B. Luce, to whom should be given the lion's share of the credit for the movement, was its first president. Mahan became one of the instructors, his subjects being "Naval History" and "Naval Tactics." While at this institution of learning he laid the foundation of his remarkable talent as a naval historian.

For many years the naval war college existed as a college without students. A staff of instructors was attached; men of ability, who delighted to improve their own minds by reading the wealth of military literature slowly collected in the War College library, but the bulk of the officers of the navy as yet saw no need of the education which the college professed to offer. They still thought in single ships, and considered administrative work at navy yards, and in the Navy Department, more valuable than the study of the theory of war on the sea. During these years of indifference there were several officers of high rank, whose continuous efforts to arouse interest in their brother officers to the study of the art of war finally won full recognition from the Navy Department and the Navy.

Many able officers of the navy held tenaciously to the opinion that the only place to learn the art of war was at sea. The fallacy of this belief now has been exposed. The course at the Naval War College crowds into one year a study of the experiences of many military leaders, spread over centuries of time. From the study of these experiences the naval officer student slowly masters the principles of strategy and tactics, which gives to him an

insight into causes and effects that before meant to him nothing. He learns that the skill which wins wars is not a gift of the gods, but comes only by serious research and the application of the lessons of history.

One of Napoleon's marshals has said, "That which is called an inspiration is simply a calculation rapidly made." The great master of war called his inspirations on the battle-field but timely recollections from his studies of similar circumstances or conditions. He is said to have explained his genius in war in the following reply to a question by a French Senator, "As for myself, I am always at work, I meditate a great deal. If I seem always prepared to reply to all, to meet all, it is that before undertaking anything, I have meditated a long time, I have foreseen what might occur. It is not a genius which reveals to me suddenly, in secret, what I am to say or to do in an emergency, by the rest of the people unexpected. It is my reflection, it is my meditation. I am constantly at work, at meals, at the theatre; at night I wake up to work."

The War College cannot give genius to every student. There must exist in the individual a natural aptitude for acquiring skill in the art of war. But the War College course will help to make the student a better naval officer than he would have been if he had not taken the course.

The War College is now looked upon as the means of saving the navy from a bad case of overdevelopment of certain organs. Matériel has been the fetish. The use of the fleet in war and its requirements during hostilities have been less studied in the past than the hulls of warships and the machines which go inside of them. A new day has now dawned. We who see the War College, thanks to the present Secretary, proudly turning out a score or more of graduates yearly, will be benefited by a peep into the condition existing when the college was started and was manfully struggling to live down its heinous offense against conservatism, of being a new thing. It was after the first session of the college under

Captain Mahan, who succeeded Admiral Luce as president. Let us tell it in Mahan's own words: "I well remember my own elation when they (students) went away in the latter part of November. Success had surpassed expectation. But in a fortnight Congress met, and it soon became evident that we (the War College) were to be starved out—no appropriation. I went to Washington, and pleaded with the Chairman of the House Naval Committee, Mr. Herbert; but while he was perfectly good-natured, and we have from then been on pleasant terms, whenever he saw me he set his teeth and compressed his lips. His argument was: 'Once establish an institution, and it grows; more and more every year. There must be economy, and nowhere is economy so effectually applied as to the beginnings.' In vain did I try to divert his thoughts to the magnificent ending that would come from the paltry ten thousand dollars the college asked. He stopped his ears, like Ulysses, and kept his eyes fixed on the necessity of strangling vipers in their cradle. . . . No help could be expected from the Secretary, and we got no funds."

We all know that the War College lived down its offense of being a new thing and is now considered by a large majority of naval officers as a necessary institution to be perpetuated. From the graduates of this college will be selected the officers to serve on the Naval General Staff, when the navy can persuade its civil administrators that successful preparations for war cannot be made without the help of such a body.

The need of a naval general staff has been explained so convincingly in a report made in 1903 by a board of which Secretary Moody was president, that it should still serve to persuade those who have not been convinced. Admiral Mahan was a member of this board and doubtless had a large share in forming the report.

"The spirit of our institution requires that the military *power shall* remain in strict subordination to the *civil power.* Accordingly the Secretary of the Navy has

been and will be in future, a civilian, with the consequent inevitable limitations of knowledge. Though the Navy Department is in an important aspect an industrial establishment in which ships are built and repaired and armament and equipment manufactured, it must not be forgotten that the final purpose of its existence is military, and that all business which is transacted therein has for its end the creation and employment of effective power upon the sea. It is therefore vitally important that there should be available to the civilian head of the department the most accurate military information and the best military advice. Without both he would be sure to commit grave errors, which might lead to disastrous results. Moreover, no matter how sufficient the military information may be or how many may be the officers of the navy capable of giving sound advice, if the information and advice are scattered throughout the bureaus and in the naval service and reach the Secretary only by a happy accident, they will never be effective for the guidance either of the national administration or of the representatives of the people in Congress, upon whose action ultimately the efficiency of the navy must depend. In such a case there would be power without knowledge in one place, and knowledge without power in another place. The knowledge should be available to those who have the power to act, so that the power may be exercised with intelligence."

That the spirit of our institutions requires a civilian secretary, or a naval secretary, it is all the same—each requires a general staff, and the general staff must be composed of officers who have made a thorough study of the duties they will be called upon to perform. The Naval War College offers the opportunity to every officer to prepare himself for general staff duty. We were the first nation to establish a naval war college, although after creating it we did our best for twenty-five years to strangle it, and we shall be the last to establish a naval general staff composed of graduates from that college.

The true goal of the training at a war college, be it naval or military, is efficient coördination of effort, or, in other words, unity of action. This unity can be realized only through coördinate thinking of all persons in a military service.

The navy is a collection of individual minds. If these minds are untrained the resultant is intellectual chaos. Each officer seeks to express his conception of what is right. These conceptions naturally are conflicting and work at cross purposes. Organization arranges men in methodical order to accomplish a purpose. Training injects method into their association one with another; it develops judgment and understanding among members of an organization.

The world has discovered through countless years of experience that there is always a best way of doing anything. This best way is never reached by an individual until after many failures, when he may from his own sad experience reason out the best way. Training in method uses the accumulated experiences of men. Through method comes naturally speed and precision in work. Constant practice makes the right method automatic, or subconscious. An individual fully trained selects the right way notwithstanding the distracting influences of war and battle.

Great care must be exercised in following method not to neglect the value of judgment. Method is particularly for those whose judgment is yet untrained. The higher the training in judgment the less important is method, yet it still must exist for full efficiency.

Judgment is a product of understanding.

It seems to be a human failing that in the high places of an organization where judgment and understanding should be most prominent, the effort towards further development is weakest. This is because the high positions are removed from criticism.

The training of subordinates goes on under definite *rules methodically* laid down and the results thoroughly

inspected. The higher officers being removed from inspection, too often neglect this training in judgment through understanding. Yet the later training for the higher officers is even more important than the training of the subordinate officers. The War College now directs this training of the higher officers and jealously inspects the results achieved by these officers while at the college. The General Staff should inspect the results in the fleet.

The War College aims to train the higher officers of the navy to command. It does this through a training in method.

Every situation with which an individual is confronted requires thought, either conscious or subconscious, in order that the correct action will be applied. If the individual is a subordinate officer of the navy this situation must be considered in connection with orders or instructions previously received from higher authority.

The intellectual acts of an individual in command of a military force should be molded to follow after methodical thought in the following order: (1) A clear grasp of the intention of instructions; (2) a reasoned examination of all conditions bearing on the situation; (3) a determination of intention; (4) the communication of intention with instructions to subordinates.

This method is not alone applicable to the military service, it is equally useful in all activities where action is required from several persons all working toward a common purpose.

As an example let us consider a subordinate commander of a scouting force. His vessels are deployed on a scouting line, steaming at high speed to search for an enemy fleet in the neighborhood.

One scout cruiser sights smoke ahead, and soon discovers an enemy scout cruiser. He must decide quickly whether he shall give battle or flee. There is no time for indecision. The two vessels are approaching each other at express train speed. His individuality counsels a combat. Yet does giving battle conflict with his in-

structions? He remembers that "coördination of effort, unity of action" is the aim. Has he a clear grasp of the intention of his instructions? What are they?—"To discover position, numbers, types, intentions enemy fleet." If he gives battle to the enemy scout his own ship might be sunk and he therefore could not gain the information sought by higher authority. He makes an examination of conditions and unerringly decides (determines his intention) to evade the enemy scout if possible; if not, to call up the supporting ships and overwhelm the enemy's opposition. He announces by radio (wireless) the position of enemy scout sighted and retires before it.

The commander of the scouting force or the commander of the supporting warships, usually battle cruisers, upon receiving this information must then go through the same course of reasoning. He arrives at the decision to steam to the support of the scout making the "contact," and directs the scout to fall back until joined by sufficient fighting ships to force back the enemy scout.

The scout when joined by the supporting battle cruisers or other vessels then turns. This time the enemy scout is seen to be fleeing. The scout and its supports do not pursue the enemy scout, although to do so is but human; they maintain the course set by higher authority. To be led from their scouting service by a desire for personal glory detracts from unity of effort.

A faithful carrying out of the intention of instructions leads the scout with its fighting supports into the midst of the enemy fleet and the intentions of the commander-in-chief are thereby carried out.

To train officers to act with judgment and understanding in war is the goal of war college effort. It is not enough to give officers lectures upon what to do under a variety of imaginary cases, for it was found that men's memories are not retentive unless the lesson can be in some manner forcibly impressed on their minds. Something had to be devised. The best training is in war,

but a war could not be made merely for the training of officers.

"If it were not for the stimulus of necessity, all effort in the world would stop, and the universe would come to an end. Therefore if we want to spur up action, and the *real* necessity is not available, we must create an *artificial* one."

The war college created an artificial war. It was at first called the "war game."

It was unfortunate that the term "game" was used. It had a depreciating effect, especially from those who were inclined to scoff at the war college. Lately the term war game has been dropped and the term "chart manœuvre" substituted. This term is a happy one, for it accentuates the fact that the strategist's real field of operations is the chart. Jomini calls strategy "war on the map."

Many persons, both in and out of the service, have often asked, "What are the duties of the Naval War College?" This question has been answered in many ways. Some answer it by implying that the war college acts as a general staff for the navy. That it formulates war plans and guides the Navy Department in the development of its naval policy.

This, however, is not the true goal of war college effort. The college should be above all an academy for the instruction of naval officers in the higher lessons of naval policy, administration, strategy and tactics. Its effort should be to develop a doctrine of naval war for our naval service. It should through its teachings standardize the navy's thought on naval affairs, to make each naval man, line and staff take the same view of all naval matters.

The war college has no affair with the administration of the navy. It should teach principles to be applied in *the navy at large.* Its graduates should be equipped to *handle intelligently* the perplexing and often contradictory *situations* that arise in the everyday life of the

navy, to fill any office under the Navy Department or at sea.

It is not a part of a general staff but merely the school in which general staff officers are trained.

The present course at the Naval War College is of one year's duration. It comprises a reading course on the subjects: Policy, Organization, Administration, Finance, Strategy, Tactics. Several hundred books on these subjects are recommended for reading and the student is directed to read thoroughly as many of these as he is able in the time given to each subject.

Each day the students are trained in the use of the tactical manœuvre board, where miniature battles are fought out.

Periodically a chart manœuvre is played; this is a war on the chart and is carried on with as much seriousness as if a war were actually in progress.

It is unnecessary to call attention to the fact that the real fleet is not even at the free disposal of its own admiral. While at the college we can give an entire forenoon, if necessary, to work out and analyze a five-minute critical movement, we can on the other hand dispose of a day, or week, or a month in less than an hour.

It must be admitted that the chart manœuvre and the manœuvre board have facilities greatly in excess of the fleet.

Now at first blush it may be a little startling to be told that for the conduct of a naval campaign the presence of the fleet is not necessary. Strategy has been called, as we have seen, "War on the *Map*." A little consideration will show that ordinary navigation is merely "*sailing on the chart.*" A walk on deck gives no idea where the ship is, but a glance at the chart in the cabin does. In like manner it is on the chart that the admiral plans and conducts his cruise.

Even on the tactical field with the enemy in sight, the *picture on the retina* is a distorted representation, which *in the mind must* be reduced to a proper diagram. The

adjoining ship seems large; those further away diminish in proportion to distance; speed across the line of vision seems very great; that along its direction comparatively slow. Even the actual witnesses to a battle do not have a clear idea of what has taken place until it has been reduced to a diagram. This was clearly demonstrated in the battle of Jutland.

The Tactical Manœuvre Board and the Chart Manœuvre.—Success in any art requires practice. Instruments and a knowledge of the principles governing in their use is essential; however, *skill* in the use of the instruments and the trained judgment to apply the principles can be obtained only through practice.

The naval art is the art of war. Our instrument is the fleet. Naval officers spend many years of their career ashore and afloat acquiring the intricate details of the sailors' profession; the science of ship construction, ordnance, engineering in all its forms, navigation and the art of seamanship are not unstrange to them. They understand thoroughly the ship, the single unit of a fleet. The final training in the art of handling the fleet, the cohesive embodiment of the national force on the sea, can be begun without going to sea and without a fleet. It cannot, however, be completed.

Experience alone can give skill. Experience in war can come to but few, and there is no time after the beginning of war for training. On the tactical manœuvre board, days, months, even years of training are possible. This is the sub-calibre method of training naval tacticians. The map manœuvre is the sub-calibre method of training naval strategists.

In the early part of the last century Germany, stinging under her humiliations at the hands of Napoleon, set industriously to apply scientific methods to the solution of the problem of conducting war. The war game or the "map manœuvre" was invented and constantly used by German military officers. This war game or map manœuvre was a notable factor in the wonderful success

achieved by German arms against Austrian in 1866 and French in 1870. Every step of both campaigns had been "rehearsed" many times by the German military officers who were to carry them out in the event of war.

There were certain French army officers previous to 1870 who had endeavored to awaken their countrymen to the need of applying the German scientific study of war to their own case. They were unsuccessful and when war became inevitable the French commander-in-chief, in a response to an inquiry of the Emperor, said that the French army was ready to the last gaiter button. This remark, apparently innocent, contained the germ of defeat for France. It clearly betrayed the fact that the higher officers of the French army were more centred on the matériel than on the management of their army in the field against a foe, and in consequence, while the German mobilization went forward with the precision of clock work, the French mobilization was confusion worse confounded.

From a naval standpoint it is both interesting and instructive to learn that the British victories at sea against the French in the latter part of the eighteenth century were made possible by the lessons learned by the high ranking British naval officers through the use of a manœuvre board not unsimilar to the one now in use at the Naval War College, devised by a Mr. Clerk, "The Laird of Eldin," a civilian interested in naval matters.

The following will be found in the introduction to Clerk's Naval Tactics:

"The splendid results which followed Mr. Clerk's discoveries in naval tactics, sufficiently attested their value and importance. The publication of his theory forms indeed an era in the annals of maritime war. If we look to the battles which were fought prior to this, we find, notwithstanding the valor and enterprise both of our officers and seamen, that, with few exceptions, they were all indecisive and unprofitable. The object of our enemies, conscious of inferiority in close action, was to avoid

battle, and to act entirely on the defensive; and for this purpose they had brought to perfection a system of skilful manœuvres, by which they always contrived to disable and keep at a distance the hostile fleets of Britain.

"Hence the British commanders were always foiled in their attempts to force on a close action; and though they often encountered the enemy's fleet, they generally parted, after some indecisive and distant cannonades.

"The simple, bold, and decisive manœuvre of passing through the enemy's line, suggested by Clerk, and of which he demonstrated the efficacy in a variety of the most conclusive illustrations, effected a complete revolution in maritime war, and gave a new and brilliant aspect to our naval history. The conflicts of hostile fleets were no longer signalized by the triumph of defensive tactics. The skilful mode of attack now adopted never failed to bring on a close and general action, in which valor was sure to triumph; and since this period accordingly, a succession of the most brilliant victories has adorned our annals."

Mr. Clerk in his preface says:

"As I never was at sea myself, it has been asked, how I should have been able to acquire any knowledge in naval tactics, or should have presumed to suggest my opinion and ideas upon that subject. The following detail, which I trust I shall now be excused from entering upon, will, it is hoped, obviate every prejudice of this kind."

In the course of this explanation and speaking of his study of Byng's Action, he says:

"The attack in this battle (Byng's Action) was from the windward; and as it appeared to me extremely ill conducted, the subject occupied my mind for years. In this discussion I had resource not only to every species of demonstration, by plans and drawings, but also to the *use of a number* of small models of ships which, when *disposed in proper* arrangement, gave most correct representations of hostile fleets, extended each in line of battle;

and being easily moved and put into any relative position required, and thus permanently seen and well considered, every possible idea of naval system could be discussed without the possibility of any dispute," and further in reference to the war then in progress:

"In the meantime, so often as dispatches with descriptions of these battles were brought home, it was my practice to make animadversions, and criticize them by fighting them over and over again, by means of the aforesaid small models of ships, which I constantly carried in my pocket, every table furnishing sea-room sufficient on which to extend and manœuvre the opponent fleets at pleasure; and where every naval question, both with respect to situation and movement, even of every individual ship, as well as the fleets themselves, could be animadverted on; in this way not only fixing and establishing my own ideas, but also enabling many landsmen to form a judgment with respect to the subject of tactics as well as myself."

Clerk by the means of a manœuvre board of his own devising found that what the British admirals had called French defeats were actually successes of the French tactical methods. He discovered the method and recommended a plan to defeat it.

As has been stated above, the object of the tactical manœuvre board is to furnish a "practical field" for the acquirement of experience and in consequence skill in the conduct and direction of battle. The chart manœuvre furnishes a similar practical field for the testing out of strategical war plans.

These two methods offer the world as a stage and place no limit on the forces employed, either as to numbers or types. Any type of ship may be had for the asking, the only requirement being to state its qualities so they may be expressed in game convention. The ships, too, can do what in time of peace is impracticable to the real ships: *for example, they* can ram the enemy or destroy him with *gunfire; they* can run all sorts of risks, nay, can be de-

stroyed to prove the inefficacy of a poor plan, and in a twinkling they can be restored for a new trial. And all these things are at the disposal of any group of officers gratis.

Chart Manœuvre.—The chart furnishes the theatre of operations. The object of the "war on the chart" is to hunt the enemy and fight him. Strategy is used to hunt the enemy in order to fight him. Tactics does the fighting. Chart manœuvre stops when the battle begins.

Tactical Manœuvre Board.—The manœuvre board (a square flat surface representing the surface of the sea) furnishes the scene of conflict. The object of battle is to seek position and strike. Tactics is used to seek position in order to strike. Gunnery does the striking.

The chart manœuvre can be played anywhere and at any time. The material used is inexpensive and readily obtainable. The officers to contest in the manœuvre are divided into two sides; each side is denoted by color. Umpires and recorders are selected.

The statement of the war problem to be solved, prepared in advance by the instructor, is divided into two parts—the general situation and the special situation. The former is known to both sides, the latter is that which is known only to each for his own side. There may be in addition certain conditions known only to the umpire; this information will be given to the contestants only at the proper time.

The problem being given to the two selected commanders-in-chief is carefully studied. They must designate the exact task assigned and must state it in simple and understandable terms. The next step is to consider the difficulties that must be encountered in accomplishing the task set; then the means at hand to overcome the difficulties. From a careful consideration of these a decision is reached as to the proper means to be employed.

Each commander-in-chief is given sufficient time to *study thoroughly his* problem and then organize his forces *for the work in* hand. He writes his campaign order,

distributing his forces, assigns officers to each force, giving each a task and linking up each task to a definite and clear intention binding upon the force as a whole.

If these same officers have taken part in many chart manœuvres together, there will exist an understanding between them. They will have learned each other's methods of thought and will know what action to expect under many dissimilar situations which have arisen before. They will be bound together by doctrine or mutual understanding upon the conduct of a chart manœuvre.

After each side has completed its preliminary work, on a small scale has constructed a war plan to conduct the war as outlined in the problem, these solutions are handed in by each side to the umpire.

Next comes the trial of strength.

The umpire places the contending forces in separate rooms. No communication is allowed between them except via the umpire.

The umpire announces the beginning of the first move and directs each side to plot all their forces on the chart at that hour. Commanders of detachments separated are placed in separate rooms.

Each side, each distinct force, or the senior leader of a combined force plots his projected move on the chart from the beginning to the time of the end of the move as announced by the umpire. If the contending forces are separated by many miles, a move may be of one or two days' duration. If the two forces are in close proximity, moves may be of one hour length and even less.

A tracing on thin paper is made of each force after being plotted on the chart and these transfer sheets are sent to the recorder who plots both sides on the umpire's chart. The umpire thus has before him the projected move of both sides. If no contacts are made, that is if no vessels are sighted which would alter a projected move, then the next move is announced. If contacts are made, *then each side concerned* is informed and the move can be *modified; moves* are thereafter made carefully after full

full information of all contacts is given and acted upon.

Communication between vessels in sight is by signal and those not in sight of each other by radio, and all in code so that they cannot be intercepted by the enemy. Every means is employed to make the chart manœuvre realistic and success in that undertaking is shown by the absorbing interest taken by all students at the college.

Rules and manœuvre conventions and values are all laid down in book form and each officer must be familiar with them.

The chart manœuvres give subordinates experience in grappling serious situations. That these situations are not real, does not deprive the subordinate of the opportunity to show his ability in forming his decision quickly and correctly. They are in the strictest sense a test of good judgment.

Our naval doctrine is full initiative to the subordinate within his area of discretion. As long as the subordinate gives full loyalty to the plan of the commander-in-chief and in his acts promotes the success of the plan, then the manner of performing the task is within his own discretion. A commander-in-chief soon learns which officers among his subordinates are guided by wisdom and which merely act upon impulse. To the latter he gives minute directions, even as to methods, for this officer cannot be relied upon to keep within his area of discretion, and if left free to use his initiative may seriously jeopardize the success of the whole undertaking.

This might be more clearly expressed: A subordinate has liberty to do *right* as he pleases and *not wrong* as he pleases, therefore the radius of the circle enclosing the area of discretion of a subordinate is directly proportionate to the subordinate's ability to do the correct thing when called upon to act, and the freedom to act at discretion, or with initiative, will depend directly on the commander-in-chief's confidence that the subordinate left to his own resources will take the correct action in the majority of situations that may arise.

The training received during these chart manœuvres binds all students together in a common doctrine of naval war. All eventually see a situation alike and the reply is the same. They come to talk a common language, as it were, and on naval subjects understand each other with "half a word."

Many of our reforms in naval matters have come about through the lessons taught by the chart manœuvre. It demonstrated graphically the need of the concentration of the fleet. It showed the localities where naval bases should be established. Scouting methods were originated for use in the chart manœuvre. The value of the present fleet organization was proved on the chart manœuvre and on the tactical manœuvre board. There are other points of minor importance which have come to notice through these make-believe wars and battles; even International law has been affected by the chart manœuvre.

The secret of the virility of the chart manœuvre lie in the fact that there is in the next room a real live enemy waiting to take advantage of any mistake or to show the fallacy of a scheme not the result of deep thought and careful preparation.

The chart manœuvre is the Morris tube of naval war and has been quite as successful in training officers for war command as has the Morris tube in training gun pointers to shoot accurately.

It is always a difficult matter to clearly define strategy and tactics, yet these must be clear in the students' minds before they can grasp the principles of naval war. For any military duty there must be a "mission," the thing to accomplish. Having decided upon the mission, then the "decision"—the means of accomplishment—becomes the direct consequence; it is the act to carry out the mission. If no mission is recognized, then no decision. and of consequence no action, no fight. A fight, on the other hand, without a mission, is action without purpose. Brute *force without brain.*

War strategy in distinction from war tactics may be

said to be the field of war from the point of view of one with an object to attain, while tactics is the field of war from the point of view of the executor.

While the distinction between strategy and tactics is clear enough, yet we have some difficulty in laying down a line between them; each appears to encroach upon the other's domain. This fact is sufficient to show their movement of approach is from opposite sides. Strategy then is the idea seeking materialization, a thought seeking its means of execution, while tactics gives the materialization of the idea and the means of carrying out the desires of the thought.

It has been said by many writers that tactics is the servant of strategy, the truth of which is evident from the reasoning given above. A tactical problem without a strategical setting is like a quotation without the context. We must keep in mind the master idea which is found in the strategical setting.

Success in any art or science is a product of three all-important factors: (*a*) the right thing, (*b*) rightly applied, (*c*) in time.

If either of these factors is zero, the result will be zero. The right thing rightly applied too late; the right thing misapplied, and the wrong thing whether applied in time or not—none of these combinations promises success.

The right thing can be learned from the study of the experience of past wars and from artificial wars—chart manœuvres, checked up by the work in the fleet itself. The constant practice of artificial war, giving intimate and comprehensive knowledge of various theatres of war and of the use of types of vessels under many varieties of situations, will show us how to see "the right thing" "rightly applied."

Finally it is necessary to train our mental processes that the proper line of reasoning becomes the line of least *resistance. In this* way we think right, even though there *is no time to think* at all. We shall then be able to see *the "right thing* rightly applied" in time.

CHAPTER XXII

ORGANIZATION OF THE NAVY DEPARTMENT FOR THE ADMINISTRATION OF THE NAVY

History.—In 1775 Congress passed a law establishing a "Marine Committee," to consist of three members of Congress. The Committee was given control of all naval matters.

In 1776 a "Continental Navy Board," consisting of three competent persons, was established, subordinate to the "Marine Committee."

In 1779 the "Marine Committee" and "Continental Navy Board" were abolished and the control of naval matters placed under a "Board of Admiralty," consisting of five members, two being Congressmen.

In 1781 the Board of Admiralty was abolished and a "Secretary of Marine" created, in whom was vested all the powers and duties of the preceding Board. The title of this Administrator was a few months later changed to "Agent of Marine."

In 1789 the navy was placed under the control of the "Secretary of War."

In 1789 a "Navy Department" was established at the Seat of Government, under the control of a "Secretary of the Navy."

In 1815 a Board of Commissioners, composed of captains in the navy, was authorized by Congress. The Board was presided over by the Secretary of the Navy.

In 1842 five "Bureaus" were established under the Secretary of the Navy, to take the place of the Board of Commissioners.

The original Bureaus were: (1) Navy Yards and Docks; (2) Construction, Equipment and Repair; (3) Provisions and Clothing; (4) Ordnance and Hydrography; (5) Medicine and Surgery.

At present the business of the Navy Department is divided among the following Bureaus: (1) Yards and Docks; (2) Navigation; (3) Ordnance; (4) Construction and Repair; (5) Steam Engineering; (6) Supplies and Accounts; (7) Medicine and Surgery.

The Functions of the Navy Department.—The Navy Department's duties consist of those necessary to provide for the needs of the fleet and for all the foreseen demands of a state of war.

Such duties embrace subsistence of men, coal, oil, ammunition and supplies in general, warships of all types required, transports and auxiliaries, supply of officers and men, transportation of men and supplies; provision of and administration of dock yards and naval bases, ordnance, torpedo and mine construction, estimating, accountability, payments, recruiting and in general the receipt and proper application of money.

The aim of Navy Department administration is to provide a navy equipped for war.

At the head of the Navy Department is the Secretary of the Navy. He is the representative of the President of the United States, the Constitutional Commander-in-Chief under whose direction his authority is exercised.

The duties under the Secretary divide under two principal heads, closely related: Military and Civil. The civil duties embrace the provision or preparation of all matériel of war. These duties are performed by the seven bureaus. The military duties concern the use of that matériel, whether in war or in such exercises as conduce to fitness for operation of war.

The military duties at the Navy Department are performed by the General Board and the office presided over by the Chief of Operation. The General Board is merely advisory. The Chief of Operations derives his power and responsibility from the Secretary of the Navy. The Secretary of the Navy can delegate from all to none of his power to the Chief of Operations. Thus, in a great measure, the efficiency of the Navy Department and conse-

quently the navy, depends upon the ability, judgment and good sense of the Secretary. Under the law he can retain personal charge of each activity. There exists no detail of naval administration which he may not himself personally supervise. He can be fairly swamped by the multitudinous and technical details involved in the performance of his duties, thus impeding the navy's business, else he can delegate to the Chief of Operations and the seven Bureau Chiefs duties and responsibilities appropriately belonging to them, thereby freeing himself from technicalities with which he cannot be familiar and keeping to himself the more important and broader service of superintending and coördinating the various conflicting elements which invariably arise in an organization composed of men of acknowledged ability in subjects differing widely in scope and constituency.

The business of the Navy Department is according to law to be "distributed among the several bureaus in such manner as the Secretary of the Navy shall judge to be expedient and proper."

The General Board.—This board was established by order of the Secretary of the Navy in March, 1900. Secretary John D. Long in his written order describes the purpose of the order in the following words:

"The purpose of the Department in establishing this board is to insure efficient preparation of the fleet in case of war and for the naval defense of the coast."

The General Board was originally composed of: the Admiral of the Navy, the Chief of the Bureau of Navigation, the Chief Intelligence Officer and his principal assistant, the President of the Naval War College and his principal assistant, and three other officers of or above the grade of Lieutenant-Commander.

The present board consists of the Admiral * of the Navy, the Chief of Naval Operations, the Major-General Commandant of the Marine Corps, the Director of Naval Intelligence, the President of the Naval War College and

*Admiral Dewey has died since this was written.

such other officers at the discretion of the Secretary of the Navy.

The duties of the General Board are outlined in the U. S. Navy Regulations as follows:

1. The General Board shall devise measures and plans for the effective preparation and maintenance of the fleet for war and shall advise the Secretary of the Navy as to the disposition and distribution of the fleet and of the reënforcements of ships, officers and men of the Navy and Marine Corps.

2. It shall prepare and submit to the Secretary of the Navy plans of campaign, including coöperation with the Army and the employment of all the elements of Naval Defense, such as the Naval Militia, Coast Survey, Lighthouse Service, Coast Guard and Merchant Vessels, and shall constantly revise these plans in accordance with the latest information received.

3. It shall consider the number and types of ships proper to constitute the fleet, the number and rank of officers, and the number and ratings of enlisted men required to man them, and shall advise the Secretary of the Navy respecting the estimates therefor, including such increase as may be requisite, to be submitted annually to Congress.

4. It shall advise the Secretary of the Navy concerning the location, capacity and protection of fuel depots and supplies of fuel, and of Navy Yard and Naval Stations; also in regard to the establishment and maintenance of reserves of ordnance and ammunition and depots of supplies; and shall advise as to the delivery of provisions and stores of every kind required by the fleet.

5. It shall coördinate the work of the Naval War College and the office of Naval Intelligence and shall consider and report upon naval operations, manœuvres, tactics, organization, training and such other subjects as the Secretary of the Navy may lay before it.

Previous to the establishment of the General Board, *the Navy Department*, through its bureaus, was well *enough prepared to* build, gun, engine, equip, repair, sup-

ply, officer, and man its ships and keep up the necessary public works on shore; in other words, the inanimate fleet of ships and naval bases are the concrete productions of the labors of the material bureaus of the Navy Department, the Bureau of Navigation providing the officers and men, but until the General Board came into existence there existed nowhere within the Navy Department an organization to determine how the weapon was to be prepared in peace and used in war.

The General Board is advisory, but due to its continuity in membership and of its records has naturally been of great service to the nation in outlining broad questions of naval policy and strategy and presenting them concretely to the Secretary of the Navy in a form which a civilian can understand. It has no legal status and may be dissolved by the order of the Secretary.

The Chief of Operations shall, under the direction of the Secretary of the Navy, be charged with the operation of the Fleet and with the preparation and readiness of plans for its use in war.

He has the direction of the Naval War College, the Office of Naval Intelligence, the Office of Gunnery Exercises and Engineering Performances, the operation of the Radio Service and of other systems of communication, the operations of the Aeronautic Service, of Mines and Mining, of the Naval Defense Districts, Naval Militia, and of the Coast Guard when operating with the Navy.

He directs the consideration of all strategical and tactical matters, organization, manœuvres, target practice, drills and exercises, and of the training of the Fleet for war; the preparation, revision and enforcement of all tactics, drill books, signal codes and cipher codes.

The orders issued by the Chief of Naval Operations in the performance of his enumerated duties "shall be considered as emanating from the Secretary of the Navy, and shall have full force and effect as such."

He is charged with the preparation of Navy Regulations, Naval Instructions and General Orders.

He advises the Secretary of the Navy concerning movements and operation of vessels and prepares orders in regard thereto. He keeps the record of service of fleets, squadrons and ships.

He advises the Secretary of the Navy in regard to: Military features of new ships, extensive alterations of ships affecting military value, features affecting military value of dry docks and their location, matters pertaining to fuel supply, location of radio stations, reserve ammunition and ordnance, and stores. In fact, he advises as to the necessary and foreseen demands of the fleet.

He apportions the war plans to the several bureaus, in order that they may be prepared to carry out their parts.

He witnesses periodically the operations of the Fleet.

He is allowed fifteen assistants and is ex-officio member of the General Board.

It may be noted that the Chief of Operations is charged with duties similar to those performed by the General Board in an advisory capacity. Eventually these two offices must merge in order to gain closer coöperation.

The Bureaus

Bureau of Yards and Docks.—The Officers of this Bureau are by profession Civil Engineers. They are graduates of scientific colleges or of the United States Naval Academy.

The duties of this Bureau fall under the following heads: (*a*) public works and public utilities; their design, construction, repair, upkeep and operation; (*b*) power plant operation; (*c*) furniture for quarters and offices; (*d*) general naval station care and maintenance; (*c*) land, its care, custody and improvement.

These duties are essentially shore duties. The Corps of Civil Engineers are Staff Officers and do not go afloat. They perform all their duties either in the Navy Department or at Navy Yards or Naval Stations.

Public works and public utilities for the Navy comprise the following major items:

1. Buildings of all kinds and their permanent fixtures.
2. Harbor work.
3. Water front improvement.
4. Docks of all kinds, including graving docks and floating docks and their machinery.
5. Power plants and their machinery, including distributing systems for all purposes.
6. Radio stations, except radio equipment.
7. Roads, streets, tracks, etc.
8. All hoisting appliances outside of shops at Navy Yards and Naval Stations, such as floating and land cranes, derricks, etc
9. All transportation equipment.
10. Steam shovels, dredges, pile drivers.
11. Fire apparatus.

This Bureau submits its own estimates to Congress and controls the money appropriated.

This Bureau apportions the money allowed by Congress for the services enumerated above to the several Navy Yards and Naval Stations, unless an appropriation has been specifically made by Congress for an individual locality. Recommendations are made by the heads of the Navy Yards and Stations to the Bureau, as to the amounts desired to carry on the work of Yards and Docks at the Station. The Bureau has the final decision, always subject to the action of the Secretary of the Navy.

All employés of this Bureau, with the exception of the officers who form the corps of Civil Engineers of the Navy, are civilians.

Bureau of Navigation.—The functions and duties of this Bureau may be divided into fifteen parts. The subject of navigation is covered, but the word nowhere appears as a distinctive specialty of the Bureau. The Bureau's principal function is not navigation, but the supply and control of personnel. The officers in this Bureau are all line officers.

The Bureau's duties may be grouped under the follow*ing general headings*:

1. Establishing the complements of ships of the Navy.

2. Appointments and commissioning of officers and men.

3. Enlistments, assignment and discharge of enlisted men.

4. Training and education of line officers and enlisted men.

5. The issue, record and enforcement of orders to officers.

6. Records of officers and men.

7. Discipline, rewards and punishments.

8. Estimates for pay.

9. Uniform regulations.

10. Naval ceremonies and etiquette.

11. Naval Militia and Naval Reserve.

12. Navigation: (*a*) Naval Observatory, (*b*) Hydrographic Office.

13. Radio Communication.

14. Naval Defense Districts.

15. Aviation (personnel).

The "complement of ships" is the natural basis upon which to calculate the strength of the personnel of the navy. For every ship of the navy an allowed complement of officers and men is established. This complement gives the rank and ratings and is based upon the duty which the vessel is intended to perform.

When ships of war are grouped into divisions, squadrons, flotillas and fleets, there must be additional officers and men for the staffs of the commanders of the groups.

Outside of the mere manning of the fleets, there must be both officers and men for the complementary duties on shore, in order to keep the fleet stocked with men. The shore duties comprise recruiting, educational and training stations, Navy Yards and Bases, Naval Reserve ships, administration duties at the Navy Department and at *Naval Stations.*

Appointments and commissions of officers: Commissions *are signed* by the President of the United States

"by and with the advice and consent of the Senate." Appointments are signed by the Secretary of the Navy.

Enlistment assignments and discharge: One division of the Bureau has entire charge of enlisted personnel. The office force required in this division may be imagined from the volume of business consequent upon nearly a hundred thousand applicants for enlistment in a single year. Of these only about 20 per cent. are enlisted. Discharges each year average 15.000.

Training and education of line officers and enlisted men: This is of the greatest importance. Too little attention is now paid to this function through the defect of a great shortage of both officers and men for the proper manning of the fleet. None should be available for other purposes until the fleet can be maintained at war strength. The educational institutions for line officers are: (*a*) Naval Academy, where the ground work for an officer and a gentleman is carefully laid; (*b*) postgraduate schools in all naval technical subjects such as Engineering, Steam, Electrical and Oil, Naval Construction, Submarines, etc.; (*c*) the War College. Here the art of Naval War is studied and officers are trained for higher command duties.

For the enlisted man there are four training stations: Newport, R. I., Norfolk, Va., Great Lakes (near Chicago, Ill.), and San Francisco, Cal. At the training stations the recruits are given the elementary yet fundamental lessons of personal cleanliness and hygiene.

Classes for enlisted men are maintained at the several shore stations of the Navy, including the following subjects: Ordnance, Electricity, Diving, Torpedoes, Mines, Radio (wireless), Machine Shop, Ship Fitting, Pipe Fitting, Carpentry, Clerical, Cooking, etc.

The Bureau of Navigation must supply qualified men to the fleet; that is its function.

Officers and men are detailed to duty by this Bureau. *Officers by name and* men by ratings.

The records of the personnel of the Navy are kept by

this Bureau. Each officer and man has his individual record. It is but a matter of a few moments to find a record of an individual and know his service qualifications.

Discipline, rewards and punishments: This Bureau comments on all questions of discipline, rewards or punishments.

Passing now to the functions of the Bureau of Navigation, more appropriate to its name, there we find the Hydrographic Office, the Naval Observatory and the Nautical Almanac and Compass Office, which are directly associated with the Observatory. These are the establishments for navigation.

The duties include the supplying of navigational outfits to ships, the collection and making of charts, publication of sailing directions, surveying and deep sea sounding, and the dissemination of nautical, hydrographic and meteorological information to the United States Navy and Mercantile Marine.

The Naval Observatory, which in its administration includes the Nautical Almanac and Compass Office, conducts astronomical and research work, prepares the Nautical Almanac, maintains the time service for the whole country east of the Rocky Mountains, tests, rates and issues chronometers, tests and issues compasses and other navigational instruments and gives special instruction in compass work.

The Naval Observatory in Washington, D. C., has long enjoyed a reputation for work of the highest character.

The Hydrographic Office keeps in touch with the Mercantile Marine of the world. Branch offices are located at each important commercial port in the United States. A voluminous business of exchanging information on maritime affairs is carried on by various means.

The personnel of Radio Service, Naval Defense Districts and Aviation are also cared for by this Bureau. Each, however, is directly under an officer who handles all the details; the money for the material required by these services is provided by the several bureaus.

Bureau of Ordnance.—The officers of this Bureau are all officers of the line of the Navy.

The duties of the Bureau as assigned by the Secretary of the Navy through the medium of Naval Regulations are broadly as follows:

1. The provision of the offensive and defensive arms and apparatus of the Navy.

2. The management of certain shore stations at which this material is produced and tested.

3. Installation on shipboard of certain parts of the armament and, in conjunction with the Bureau of Construction and Repair, the design and installation of other parts of the armament.

The offensive and defensive arms and apparatus of the Navy comprise guns and gun mounts, ammunition hoists, rammers for loading ammunition into guns, electric and other motors for operation of guns, gun mounts, hoists and rammers, gun sights and telescopes for same, range finders, explosives, smokeless powder, torpedoes and mines, tubes from which torpedoes are fired, air compressors for torpedo charging, armor, projectiles, rifles and infantry equipment, apparatus for the control of gun fire, and many other items of less importance.

The Bureau maintains a factory at the Washington Navy Yard, where many of the guns for the Navy are designed and built. At Newport, R. I., the Bureau designs and builds a large proportion of the torpedoes and mines used in the Navy.

Guns and mounts are built for the Navy by private firms, among them the Bethlehem and Midvale Steel Companies, and the American and British Manufacturing Company. The Army Watervliet Arsenal also furnishes guns for the Navy.

Powder for the Navy is manufactured at the Navy Powder Factory at Indian Head. Five private firms have in the past developed and furnished powder for the Navy; E. I. du Pont de Nemours Powder Company is the most important.

Armor is not manufactured by the Government; the last Congress, however, appropriated money for an armor plant.

Projectiles are furnished by private companies, in accordance with Bureau specifications.

Telescopes and other optical instruments are manufactured by private firms or bought in open market.

All naval guns are proved on the Government reservation at Indian Head.

Ammunition is assembled for delivery to warships and reserve ammunition is stored at naval magazines under the control of the Bureau. The locations of the magazines are: Boston, New York, Philadelphia, Norfolk, Mare Island, Puget Sound. The magazine in each case is situated a safe distance from the city or any populous habitation.

The business of the Bureau of Ordnance is to provide the best possible weapons and apparatus of offense and defense, to furnish all possible information and assistance to the personnel, to enable it to make the most efficient use of this apparatus, and to see that all legitimate needs and demands of the fleet are promptly and fully met. It has no authority to prescribe methods for using the apparatus, but may give instructions as to its care, preservation and disposition. In the matter of drills, target practice and actual war use of ordnance, the Bureau acts in an advisory capacity only to the Department.

Bureau of Construction and Repair.—The officers of this Bureau are all of the Construction Corps of the Navy. The original designation when established in 1842 was "Construction, Equipment and Repair." Until 1853 the Chief of the Bureau was a captain in the line of the navy, but in that year an act was passed by Congress "that the Chief of the Bureau be a skilful Naval Constructor, as required by the Act approved August 31, 1842, instead of a captain in the navy." The Chief of this Bureau from 1853 until 1871 was John Lenthall. He was not a naval *officer until 1866,* when by an Act of Congress the Con-

struction Corps of the Navy was established, and he was commissioned a Naval Constructor in the Navy.

The duties of the Bureau of Construction and Repair comprise the responsibility for all the structural strength and stability of all ships built for the Navy. This Bureau has cognizance and is responsible for all that relates to designing, building, fitting and repairing the hulls of ships, turrets, spars, capstans, windlasses, steering gear and ventilating apparatus, also the supports for engines, boilers and auxiliaries supplied by the Bureau of Steam Engineering.

In consultation with the Bureau of Ordnance, it designs, constructs and installs ammunition hoists, places and secures the armor to ships, installs the permanent fixtures of the armament. Working jointly with the Bureau of Ordnance it designs, constructs and installs the supports to the armament, such as turret bases, roller paths, and gun emplacements generally. The turret-turning machinery is designed and installed by this Bureau, after consultations with the Bureau of Ordnance. In general, all apparatus which is worked into the structure of the hull must be installed by this Bureau.

It has charge of the dry-docking of ships and the work on the hull of the vessels in dock.

It manufactures anchors and cables, boats of all kinds carried by warships, supplies cordage, rope, rigging, sails and awnings, flags and bunting, galley furniture and fittings, rugs, carpets and furnishings of officers' rooms and mess rooms on board ship.

The line of meeting of the Bureaus is not always clear; Ordnance, Construction and Repair and the Bureau of Steam Engineering must therefore work in close coöperation in order to fill in the twilight zone of things not covered by law or regulations.

Bureau of Steam Engineering.—The Navy Regulations thus define the duties of this Bureau: "Its duties shall comprise all that relates to designing, building, fitting out and repairing machinery used for the propulsion

of naval ships, the steam pumps, steam heaters, distilling apparatus, refrigerating apparatus, all steam connections of ships, and the steam machinery necessary for actuating the apparatus by which turrets are turned."

To attempt to give in detail a list of the material for which this Bureau is responsible would be most confusing. However, broadly speaking, it is as follows:

(*a*) Boilers, the main engines and everything necessary for their operation; (*b*) engine bedplates, stern tube linings, stuffing boxes and bearings for propeller shafts, propellers, oil and water service, reversing gear; (*c*) forced draft blowers for boilers, ducts, uptakes, smoke stacks, whistles and siren; (*d*) all steam and exhaust pipes; (*e*) steam pumps; (*f*) evaporators and distillers; (*g*) refrigerating machinery; (*h*) machine tools on board ship in use by engineer force; (*i*) the heating system; (*j*) electric wiring throughout the ship, except such as comes under the Bureau of Construction and Repair; (*k*) dynamo and motors and accessories in general.

Although the above outline is correct in the main, there are many apparatus and fittings mentioned above over which other bureaus have some measure of control. The three principal bureaus therefore must work coördinately to make sure the entire field is covered and that no hiatus is left.

Bureau of Supplies and Accounts.—This Bureau is divided into two sections: (*a*) the section of Supplies and (*b*) the section of Accounts.

(*a*) The duties of the section of Supplies comprises all that relates to the purchase, reception, storage, care, custody, shipment and issue of all supplies for the Naval Establishment, and the keeping of property accounts for the same. The Marine Corps has its own Supply Department, separate from that of the Navy. The Bureau of Medicine and Surgery also has charge of the reception, storage, care, custody, transfer, property accounts and issue of medical supplies. The Bureau of Supplies and Accounts under the section of Supplies requires for,

prepares or manufactures provisions, clothing and small stores; stationery, blank books, and forms used in rendering in property and money accounts are furnished by this Bureau. It requires for coal for ships of the navy, also expense of transportation, storage and handling the same, and also for water for ships.

(*b*) The duties of the section of Accounts comprise all that relates to the supply of funds, the payment for articles and the keeping of money accounts in the Naval Establishment.

The officers of this Bureau belong to the Pay Corps of the Navy.

Bureau of Medicine and Surgery.—The officers of this Bureau are of the Medical Corps of the Navy.

It has the upkeep and operation of all naval hospitals, medical supply depots, medical laboratories, dispensaries, technical schools for medical and hospital corps.

It approves the design of hospital ships for the Navy, in so far as concerns efficiency for the care of sick or wounded.

It requires for its own supplies and retains custody and direction of their issue.

The personnel of the Medical Corps, Dental Corps and Hospital Corps, consisting of surgeons, Hospital Corps men, dentists, nurses, etc., is administered by the Bureau of Navigation through recommendations received from the Bureau of Medicine and Surgery.

The Bureau advises the Navy Department upon all questions connected with hygiene and sanitation affecting the Naval Service. In other words, this Bureau is responsible for the health of the entire Naval Service.

Judge Advocate General of the Navy.—Revises and reports upon all legal features of Courts, Boards, etc., convened in the Navy. He prepares specifications for those courts to be ordered by the Navy Department and writes the orders for such courts.

In general, he is the legal adviser at the Navy Department *for all* questions of discipline, promotion, rank,

precedence; he drafts and interprets legislation or statutes relating to personnel. He conducts the legal correspondence of the Navy Department with the Attorney-General and with the Naval Service.

Coördination in Ship Design.—When designs for new ships are to be prepared the Chief of Naval Operations, in conjunction with the General Board, submits to the Secretary of the Navy a recommendation as to the military characteristics to be embodied.

These military characteristics include armament, armor, speed, radius of action, freeboard, period of rolling insuring a good gun platform, and other matters which must be taken into consideration by the designing Bureaus in order that the type of ship desired by the military branch may be produced if found mechanically possible within the money appropriation.

The Bureaus having part in the design, then, through conference, decide upon the main features and submit outline plans of the vessel with approximate data upon which specifications are based.

The Bureau of Steam Engineering works up the data and submits preliminary plans and specifications for the motive power and the Bureau of Ordnance, likewise for armament and armor.

These plans, after leaving the Bureaus, go via the Secretary of the Navy to the Chief of Operations and the General Board.

In conference, at which representatives of the material Bureaus are present, the plans are approved or amended to bring out military features desired.

The final plans come out of the above conference and after approval by the individual Bureaus concerned, the Chief of Operations and Secretary of the Navy form the basis upon which the ship is built.

This system of Navy Department administration over the material development of shipbuilding works satisfactorily enough except as to time. Responsibility for the vessel as a unit is divided and much valuable time is lost

in preparing plans and in the building of the ship. There are many masters to serve and no one technical individual to whom a contractor can go to settle difficulties which arise in interpretation of plans and specifications. The Bureaus cannot work in as close coördination as should obtain. Everything must be by written correspondence and the sanction of many officers must be obtained before final action is possible. The office of the Chief of Operations, lately supplied by statute, in time will give to the organization the military head which in the past it has lacked. Further steps undoubtedly must be taken to develop the military side of Navy Department Organization.

CHAPTER XXIII

ORGANIZATION AND DISTRIBUTION OF NAVY YARDS, NAVAL STATIONS, AND SUBMARINE BASES

NAVY YARDS are localities where naval ships can be docked and repaired and extensive alterations effected. The most important navy yards have been fitted also for building warships. A Naval Station is a locality where ships can be supplied with fuel and necessary stores, and in some cases minor repairs can be effected.

Navy yards at present are located at Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; Philadelphia, Pa.; Norfolk, Va.; Washington, D. C.; Charleston, S. C.; New Orleans, La.; San Francisco (Mare Island), Cal.; Puget Sound, Washington, and the Hawaiian Islands.

Of these yards the following are also shipbuilding yards: Portsmouth—submarines; Boston—auxiliaries; New York—battleships; Philadelphia—auxiliaries; Norfolk—battleships; San Francisco—battleships.

Naval Stations as defined above are located at Newport, R. I.; Key West, Fla.; Guantanamo, Cuba; Cavite, P. I. The Naval Station at New London, Conn., is used as a submarine base and the station at San Juan, Porto Rico, is closed. The Navy Yard at Pensacola, Fla., closed about four or five years ago, has again been opened as an Aeronautic Station.

Thus, we see, there are seven navy yards in the Atlantic and three in the Pacific. The Washington, D. C., Navy Yard is an ordnance yard purely.

The Navy Department, Office of the Chief of Operations, issues orders assigning ships of the navy to the several navy yards. Thus, each ship has its home yard, where it goes for docking and repairs. At this yard all the plans and patterns of that ship are kept.

When a ship is due for docking and repairs, a list of items required is submitted by the ship under the headings: (1) Alterations; (2) Repairs. Alterations are approved or disapproved on their merits by the Navy Department Bureaus; repairs are taken cognizance of by the authorities at the navy yard.

Each navy yard has a line officer, usually a Flag Officer, in command, with the title of Commandant. Under this officer there is an industrial manager, selected from the Corps of Naval Constructors or from the "Line." In the latter case he is usually an officer who has made a record for himself in the service as a practical and sometimes a designing engineer officer. The navy yard, like the Navy Department, divides its duties under two heads: (1) Military; (2) Industrial. The military duties are more directly under the commandant and comprise: Administration and discipline at the Navy yard; ceremonies; sanitation; preservation of government property; relations with civil authorities and in general, everything not directly connected with the industrial organization.

The industrial organization under the industrial manager divides under: Hull Division, Machinery Division. The industrial manager is under the Bureaus of the Navy Department who direct the policy of repairs and alterations and supply the money.

The industrial work on new construction and on repairs to vessels is accomplished by these two divisions.

When a ship of the navy goes to a navy yard for repairs, representatives of these two divisions visit the vessel and personally inspect every item of repair or alteration requested. Estimates are then made, showing cost to complete each item of work requested and time necessary to complete. The industrial manager's or the Navy Department's (the Bureau having cognizance) approval is then necessary for the expenditure of the money. After approval, plans are made and the work begun. The officers of the ship under repairs inspect the work and if satis-

factory accept and sign the inspection call. If unsatisfactory the commanding officer reports the fact to the industrial manager.

In some navy yards the commandant acts also as the industrial manager.

The Bureau of Yards and Docks has to do only with the navy yard and never with work on vessels. Its duties have been explained in a previous chapter.

The Supply Department, under the Bureau of Supplies and Accounts, makes all purchases of material and keeps in stock at the navy yard, in large storehouses provided, adequate material for repairs, etc., to vessels. The supply officer is constantly advised by the several heads of the navy yard departments as to their probable future needs.

The payments to civil employés are likewise paid by an officer of the Pay Corps, known as the Paymaster of the Navy Yard.

The Naval Magazines in the vicinity of the navy yard are under the control of the commandant.

In the selection of sites for navy yards, many considerations influence decision. A navy yard should be located near a centre of trade. In other words, in close proximity to a populous city and an industrial centre, in order that labor and material can be obtained quickly and in sufficient quantities. This is not always possible, however. Many of our navy yards have sprung up through the influence of legislators and now that a navy yard exists upon which many million dollars have been spent, it is not always the wisest policy to abandon it, even though it does not fulfil all requirements.

The following requirements should be considered when examining into the value of a site for a navy yard:

(*a*) Position—it should be reasonably near important sea areas—near frequented routes of trade—sea and land.

(*b*) Communication should be adequate with large centres of supply.

(*c*) Harbor facilities should be ample—deep water *channel to Navy* Yard; to be kept clear with minimum *dredging.*

(*d*) Located near labor market.

(*e*) Healthful.

(*f*) Security—behind fortification sufficiently strong to give it and ships security.

The principle of concentration holds for a navy yard as for anything else. With seven navy yards on the Atlantic Coast to maintain, the cost of repairs to the fleet is largely increased.

If all the navy yards could be consolidated into one yard, the "overhead" charges would be enormously reduced. This might not, however, satisfy the demands of strategy, as it has the disadvantage of putting all one's eggs in a single basket.

Probably the demands of strategy would permit us to maintain three large navy yards on the Atlantic and Gulf Coasts, two on the Pacific Coast and one at Hawaii. Thus, economy and strategy might permit the closing of four navy yards on the Atlantic and Gulf Coasts. To do this, however, we would be forced to greatly extend the water fronts of those retained in order to build dry docks and wharves to accommodate the ever-increasing number of naval ships. Most of our navy yards now abut into most valuable land, owned by private individuals and the cost to acquire additional land would be very great, even prohibitive, as an initial outlay.

There is a further consideration in the principles governing in navy yard localities. It is a human nature principle. Each section of the country naturally desires its share of the labor and purchase of material required by the naval establishment. To consolidate our navy yards would take this privilege away from several sections of the country; some of them influential sections in the political fortunes of the country.

An army is said to concentrate for attack and disperse to live. This was true in the days when an army attempted to live off the country and obtained its supplies from many different localities. This rule might be construed to fit the navy yard situation. It would be

difficult to maintain our entire fleet based upon one locality. Dividing the fleet and apportioning it to several localities not only decreases the time taken for repair, but develops several repair depots, any of which might prove vital for use in war. It is difficult to forecast to an exactness what bases might be used by the fleet in war. For this reason a nation with such a long coast line is forced, despite the extravagance, to maintain bases at frequent intervals along its coast line, not only for repair and docking of the big ships, but to provide places of refresh and refit for the smaller warships.

As we are vastly increasing our navy in order to be able to enforce the national policies, it would not be wise at this time to close a single navy yard or naval station. What is required is a more economical method of distributing the money appropriated by Congress for the navy.

The submarine is destined to play an important part in the defense of our shores. Foreseeing the value of this type of vessel, the Navy Department, guided by the admiral placed in charge of the submarine service, is developing a submarine which will be suitable to our needs in war.

It has been conclusively proved that the radius of operations of a submarine depends directly upon its size. The larger the boat the more space it furnishes for carrying fuel, fresh water for its storage batteries, lubricating oil for its machinery and stores for its crew. A submarine of 450 tons displacement can maintain itself in active operation away from its base about eleven days, while submarines of about 800 tons displacement have been operated in war for three to four weeks without making port. It is necessary that our submarines cover great distances if we are to retain the power to concentrate them in case our enemy should make his maximum effort at a single point on our long coast line. We should be able to bring against him every gun and every torpedo, otherwise the complete mobility of our navy ceases to

exist. Every gun or torpedo held elsewhere is lost. We must be able to concentrate our total strength to oppose the enemy. Hereafter our submarines to be built will be of 800 tons or over.

A submarine is a vessel that requires a base from which to operate. It is, in fact, more dependent upon a base than any other type of warship. It requires at that base facilities for repairs to and overhaul of its engines; for replacement of battery cells or the plates of the cells; the renewal of the acid; the proving of its torpedoes; the repairs to auxiliary machinery, and even docking to effect repairs to hull, underwater rudders, propellers or the skegs which protect the delicate rudders and propellers. The labor on a submarine is of a very delicate nature, requiring intelligence above the average. For this reason the Navy Department has decided it is best that most of the overhaul and repair work of submarines should be done by the enlisted force of the navy. In this way, also, the secrecy of submarine development can be maintained.

A base for submarines can be either fixed or mobile. A fixed base, or shore base, is less expensive per unit submarine based thereon than a mobile base. The upkeep expense of a shore base is far less than the upkeep of a ship acting as a tender to submarines. On the other hand, a shore base, being fixed, cannot move with its submarines from one locality to another. Therefore, there must be established a number of submarine bases, each at a locality of strategic importance.

In addition to the material upkeep facilities mentioned above, there must be ample accommodations for the officers and men of the underwater vessels at each base. This is accomplished by building barracks in which the crews are housed and fed when not actually operating at sea.

The location of submarine bases is largely a question to be *decided by* a thorough study of the strategical con-*ditions involved.*

The plan for the employment of our submarines must first be decided. This is a question which rests with the General Board of the Navy and the office of Naval Operations; these two bodies form for our navy what other nations term a General Staff. Having decided upon the plan for their employment then the number and size required can be decided readily enough, provided sufficient technical advice is taken from the officers of the navy who are actually operating our submarines. The location of submarine bases can be decided only after a careful consideration of our war plans in connection with the location of existing naval stations which could be used in time of war to support submarine operations; important commercial centres; important industrial centres and private repair facilities, which in time of war could be taken over by the Government for its own use; the extent of coast fortifications to protect the bases when established, and the hydrographic conditions—depths of water permitting submarines to operate effectively. For those localities where no facilities of material or labor are available, such as in our island possessions, and where inadequate defenses of guns and troops exist, a mobile tender or mobile base is most efficient.

All of these considerations enter into a consideration of plans of employment, and the result or decision influences the distribution of submarines to localities, the selection of submarine bases and the number of mobile tenders required.

Boston, New York, Philadelphia, Norfolk, San Francisco, Puget Sound are each important industrial centres.

Key West, Pearl Harbor, Hawaiian Islands, Guam, Manila, P. I., and San Juan are each important strategic points, each being located near a focus of trade routes.

The Panama Canal is a most important strategic point, being a locality where many commercial ocean routes converge and diverge.

Portsmouth, N. H., New London, Conn., Charleston, S. C., Pensacola, Fla., and Guantanamo, Cuba, might all

become important points for submarine operations in war, and at each a navy yard or a naval station exists.

It would not be wise to expend a large sum of money in establishing submarine bases at each of these points, yet any comprehensive war plan must take into account how submarines would be operated in case the war was brought to an area in which one of these naval bases was situated.

In the selection of shore bases for submarines the following points control in the choice:

1. Position—central to important sea areas—that is, near to important lines of maritime traffic.

2. Communication—with an inexhaustible centre of supply.

3. Commodious harbor—smooth water—sufficient natural depth in channels.

4. For training purposes, near good torpedo grounds.

5. Suitable land, high and sanitary for piers, buildings and recreation fields.

6. Near open sea.

7. To be protected by land fortifications.

A submarine shore base, when once established, will be of far less expense than a vessel. It will cost slightly more than the price of one submarine. Its own upkeep will be practically nothing, for it will be used to keep in condition a score of submarines. The labor cost will be negligible. Each submarine will require in war, and should have in peace, a double crew. This extra crew will constitute the repair crew. The repair crews concentrated can form the shore base complement and can maintain the base in efficiency and be ready to relieve the operating crew upon its return from a protracted stay at sea.

CHAPTER XXIV

THE ORGANIZATION OF A WARSHIP

Extracts from Naval Instructions.—" Each department of the ship shall be organized into divisions and divisions into crews; and the watch and division officers shall be assigned to the command of gun, fire control, torpedo, powder and engineer divisions in a manner that will, in the judgment of the captain, most conduce to the efficiency of the ship as a whole, and no changes in such an assignment shall be made except to the same end. The personal command of any officer at the battery, in battle or for drill, shall include, as far as practicable, only one class of guns—heavy, intermediate, or secondary—from which command he shall not be displaced simply because of difference in rank.

" In all matters pertaining to the training of the personnel and preparation of the material for battle, and at quarters for muster, each division officer or crew leader, as the case may be, will be under the direction of his own head of department, and will report directly to him. The heads of departments shall report to the executive and receive their instructions from him.

" Divisions and crews shall be organized into four sections for duty, watch-keeping and liberty; so that battle watches may be kept on the principal battle stations, either in watch and watch or in four watches.

" No turret captain, gun pointer or gun captain shall be assigned to any duty that may interfere with the drill, exercise, and other duties of his station at the battery; nor shall any change in the composition of any gun or torpedo crew be made without the special approval of the commanding officer in each individual case.

" A station billet shall be prepared for each member of the crew, which shall assign to him his rating, watch

number, part of the ship, mess, boat, and station at quarters and fire quarters. These billets shall be given out when the crew goes on board.

"The executive officer shall prepare complete watch, quarter, station, fire, coaling, collision, berthing, and boat bills, and have them framed and hung up in some conspicuous position, after approval by the commanding officer. These must be kept complete, correct, and accessible at all times during the cruise. The boat bill must contain full directions for abandoning ship, including arrangements for providing the necessary supplies of food and water. The fire bill must contain full directions for extinguishing a fire during quarters, when the regular alarm is not given.

"The Articles for the Government of the Navy, the daily routine, daily conduct reports, all police regulations, and routine orders concerning the ship's company shall also be kept hung up in a conspicuous position. Information concerning the movements of the ship, the mails, the addresses for letters, conduct classes and records, quarterly recommendations and standing restriction lists, results of competitive drills, and other information of like nature, interesting to the crew, and proper for them to know, should be published from time to time.

"The executive officer shall see that officers and men of gun, turret, ammunition, torpedo, and range-finder crews are present at their stations at exercise, unless unavoidably absent, so that the efficiency of the crews may not be impaired by exercising short-handed or with inexpert substitutes."

As the battleship is the principal unit of a fleet, its organization will be discussed and outlined. Smaller warships follow the same principles of organization.

All military organizations should be based upon the well known, but unfortunately little followed, principle of individual responsibility. Subordination to authority is *the keystone of* administration. No matter how few *or how many individuals* may be assembled, there must

be one upon whom responsibility rests, and all others must subordinate themselves to his authority.

A body of men forming a ship's company, in order to perform the many varieties of service, must be divided into appropriate groups. Over each group there is placed a leader. The leader's responsibility should be clearly defined and thoroughly understood by himself and his subordinates.

The primary duty, in fact the end itself of a battleship's existence, is to attain an advantageous position in battle and deliver an accurate gun or torpedo fire or both.

The motive power and the battery are means to this end, but being inanimate, the organization of the personnel for using these means must be designed to obtain the maximum efficiency of each in battle.

It is to be borne in mind that the best of organizations will fail unless there is hearty coöperation on the part of all concerned. A bad organization may succeed through efficient personnel, and a good one will fail through lack of it. The value of efficiency and hearty coöperation of the personnel cannot be overestimated.

The largest group in warship organization is a division. Smaller groups are formed in order to facilitate administration.

Definitions of Guns.—(*a*) Turret guns are guns mounted in turrets; (*b*) intermediate guns are 7-inch, 6-inch, 5-inch and 4-inch; (*c*) secondary guns are 3-inch, 6-pounder and 3-pounder guns.

Definitions of Batteries.—The main battery includes those guns that would primarily come into action in a day battle. In heavy ships carrying a battery of intermediate guns, this battery would, at close range, under certain circumstances, be brought into action with the main battery. In light ships where batteries are constituted of intermediate guns, these would be the main battery. In gunboats armed with secondary guns only, such guns would be called the main battery.

The torpedo defense battery includes those guns that

would be grouped in action primarily against torpedo craft, day or night. In both heavy ships and light ships, this battery comprises the intermediate and secondary guns. In light ships, auxiliaries and destroyers it is identical with the main battery.

The Bureau of Navigation decides the complement of ships, basing their actions upon reports from the commanders of fleets and flotillas, who have carefully investigated the requirements of all types of warship from performances at battle practice.

Complement.—The following have been designated the complement of a ship:

Officers.—(1) Captain; (2) Executive officer; (3) Gunnery officer; (4) Navigating officer; (5) Engineer officer; (6) First Lieutenant; (7) Medical officer; (8) Pay officer, and a sufficient number of officers of the line and staff corps, junior in their own corps to the above, to officer efficiently the ship for battle, and to keep the material and personnel in such condition as to be prepared for battle.

When the size of the ship, or the number of officers available, is not sufficient to provide the number of senior officers given above, the duties and responsibilities of two or more of them will be combined in accordance with the provisions of the Navy Regulations.

When Marines are added to or included in the complement of a ship, a sufficient number of Marine officers to officer the Marines' division will be required.

Crew.—The complement of enlisted men is based upon the number of men required in battle and in keeping the material and personnel in such condition as to be prepared for battle. To comply with the above requirements the following must be satisfied: (*a*) A fully manned ship control; (*b*) a fully manned fire control; (*c*) a full crew for each gun of the heavy and intermediate batteries and for each torpedo tube; (*d*) a pointer group and a reduced crew for each secondary gun; (*e*) men sufficient to provide for a supply of ammunition during a protracted en-

gagement; (*f*) men sufficient for an engineer's force to maintain full speed in two watches during a protracted battle; (*g*) a sufficient force to provide for exterior and interior communication; (*h*) a sufficient force for the operation of the electric installation, including searchlights; (*i*) men sufficient to provide repair crews; (*j*) men sufficient for the surgeon's division; (*k*) the special ratings required to mess and supply officers and men under service conditions, to be utilized in filling battle stations.

Subdivisions of the Complement.—The complement of officers and men shall be organized into such divisions and crews as will be most conducive to the fighting efficiency of the ship; and upon this organization will be based all "station bills" for routine work. Fighting units, crews and divisions will be so assigned to ship's work as to be kept together and as near as possible to their battle station. So far as may be practicable, the divisions and crews performing routine work will be commanded and directed in such work by the officers and petty officers who will control them in battle. This is in order to accustom men to work together as units and to be always close to where they will be used in action in order that no time will be lost in case of emergency.

The captain is at the head of the organization of the personnel of his ship. The executive officer acts for the captain in all matters of ship administration except in the awarding of punishments, which must be done by the captain or commanding officer.

The crew, officers and men are grouped for convenience of administration and according to duties performed under six departments, viz.: (1) Gunnery Department; (2) Navigation Department; (3) Engineering Department; (4) Construction Department; (5) Medical Department; and (6) Pay Department.

The Gunnery Department, presided over by the *gunnery officer,* furnish officers and men for (*a*) turret gun *divisions,* (*b*) intermediate gun divisions, (*c*) secondary

gun divisions, (*d*) fire control division, (*e*) torpedo division, (*f*) powder division. This department is responsible for the care of the ordnance gear and the accuracy and rapidity of fire of the battery, including torpedoes.

The Navigation Department, with the navigator at its head, furnishes officers and men for (*a*) ship control, (*b*) signals, (*c*) radio. The navigation and manœuvring of the ship and the communication with other ships are the concern of this department.

The Engineering Department, the senior engineer officer in charge, provides officers and men for (*a*) main engines, (*b*) boilers, (*c*) auxiliaries. This department is responsible for the performance of the motive power of the ship.

The Construction Department, led by the first lieutenant, constitutes the repair division.

The Medical Division, headed by the senior surgeon, cares for the sick in peace and the wounded in battle.

The Pay Department, headed by the senior paymaster, has the duties of pay accounting, the keeping of all stores and supplies and the feeding of the crew.

Turret Gun Divisions.—Each 14-inch, 13-inch, 12-inch and 10-inch; each superposed turret; each 8-inch turret on the centre line; each pair of waist turrets (a turret and its opposite) together with handling room crews and men in any other way connected with the turret, constitute a division. Officers should be assigned to their divisions with due regard to their special fitness. Senior officers, as far as practicable, to be in charge of turret divisions.

Turret guns are fired in salvo, and the fire is controlled by the fire control party by means of appropriate communicating devices from designated observation points and through distributing stations to each turret.

Intermediate and secondary guns for torpedo defense are also fired in salvo. These guns are divided into groups, each with a separate control from designated

in yards. Finally to the actual distance of the target certain gun-sight corrections are made involving atmosphere, powder, wind direction, etc. From this a sight bar range is determined. In the same manner the lateral setting of the sight is determined from direction of wind, speed of ship and speed of target. The sight bar range and deflection are sent to the sight setter at the gun. The gun is then fired. The shot falls, if accurately aimed, exactly according to the sight setting. If it is short of the target, the spotter estimates the number of yards short, and if over the target then the number of yards over. The spotter is trained carefully for this important task of estimating. His estimate of this amount is added to or subtracted from the range being used at the moment. In the same way a correction of lateral setting of the sight is made. The next shot or salvo receives identical treatment until the spotter is assured that the sight bar range and deflection are correct and that the shells are hitting the target. This process of controlling the fire of great guns is defined as "fire control."

To understand the warship organization described above the following diagram of an organization is given. It is for a dreadnought with a battery of ten 14-inch guns and twenty 5-inch guns. The following plan of number- of divisions and guns is followed:

(1) Turret Gun Divisions. Turret divisions are numbered in sequence from forward aft. Guns in turrets on the centre line are numbered serially from forward aft; right guns the lowest number in turret.

(2) Intermediate Gun Divisions are numbered in sequence from forward aft, following the turret divisions. The starboard guns have odd numbers; port guns even numbers, lowest numbers forward.

(3) Secondary Gun Division. None mounted on ship used as example.

(4) Fire Control Division.

(5) Torpedo Division.

(6) Powder Division.

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(5) Torpedo Division.

(6) Powder Division.

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(7) Navigator's Division.
(8) Main Engine Division.
(9) Boiler Division.
(10) Auxiliaries Division.
(11) Repair Division.
(12) Surgeon's Division.
(13) Paymaster's Division.

(1) *First Division.*—No. 1, 14-inch turret, forward turret, Nos. 1 and 2, 14-inch guns, handling room crew.

(2) *Second Division.*—No. 2, 14-inch turret, second turret, Nos. 3 and 4, 14-inch guns, handling room crew.

(3) *Third Division.*—No. 3, 14-inch turret, third turret, Nos. 5 and 6, 14-inch guns, handling room crew.

(4) *Fourth Division.*—No. 4, 14-inch turret, fourth turret, Nos. 7 and 8, 14-inch guns, handling room crew.

(5) *Fifth Division.*—No. 5, 14-inch turret, fifth turret, Nos. 9 and 10, 14-inch guns, handling room crew.

(6) *Sixth Division.*—Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 5-inch guns.

(7) *Seventh Division.*—Nos. 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 5-inch guns.

(8) *Eighth Division.*—Fire control division.

(9) *Ninth Division.*—Torpedo division.

(10) *Tenth Division.*—Powder division, serves 5-inch battery.

(11) *Eleventh Division.*—Navigator's division.

(12) *Twelfth Division.*—Main engine division.

(13) *Thirteenth Division.*—Boiler division.

(14) *Fourteenth Division.*—Auxiliaries division.

(15) *Fifteenth Division.*—Repair division.

(16) *Sixteenth Division.*—Surgeon's division.

(17) *Seventeenth Division.*—Paymaster's division.

The ship is usually divided into sections separated athwartship, vertically, either by bulkhead or imaginary line. There should be as many sections as there are principal gun divisions in the main battery; a section to extend from the main deck, or in case of turrets, from the top thereof, to the keel, and to include everything

within its boundaries; each station is in charge of the senior officer of the gun division in that section. This officer, with his assistants, is responsible in every way for the cleanliness, maintenance and general upkeep of his section, including all appliances for heating, lighting, ventilation, safety devices, proper stowage of articles of equipage, and, in fact, responsible in all particulars for the proper condition of his section.

Men of proper rating and in proper number are assigned to the various divisions; division officers assign their men to their individual stations and submit their organization and details to the executive officer for approval (and keep him and the office of the first lieutenant promptly informed of any change in detail). Divisions manning torpedo defense guns usually care for certain unassigned parts of the upper decks, such as masts, chart-house, bridges, etc.

A warship once commissioned and organized with full complement of officers and men is expected to maintain itself in condition of preparedness for any duty. The captain, through his heads of departments, must continuously be informed of the supply of fuel, ammunition, stores and spare parts on board; of the condition of the material of the ship; engines boilers, auxiliaries, gun turrets, guns, fire control instruments, safety appliances, etc. It is imperative that each ship in the navy be kept at all times ready for instant action, the only exception being when undergoing an extensive overhaul at a navy yard, or when the complement of the ship has been reduced for reasons of economy or due to a shortage of officers and men in the naval service to adequately man the ships provided.

In time of peace a ship is said to be not "cleared for action"; that is, there are retained on board many articles for the health and comfort of the officers and men, which *during war might* be eliminated without undue hardships.

Placing a ship in condition for war is termed "*stripping ship.*" This is done when war is impending. The

crew, working in their own sections of the ship, as outlined above, remove from the ship and leave at navy yards or such other places as may be designated for safe keeping such articles as unnecessary boats; bunks; wooden furniture; wooden chests and lockers; wooden doors; spars and booms not required in war; stanchions for awning; boat davits; gangway and other ladders; unnecessary clothing of officers and men; unnecessary canvas, such as unnecessary awnings and weather cloths; steel ventilators, substituting canvas where possible; mess tables and benches; all inflammables, such as gasoline, paints, oils not needed for war purposes.

Splinter screens are rigged to protect engines and boilers from splinters of steel and from steel fragments.

Stripping ship is not considered a drill. It is done methodically and carefully. The main idea is to make the ship as safe as may be possible from fire due to the incendiary effect of bursting shells, insure minimum risk to personnel from splinters, and yet keep everything on board required for use in war. In stripping ship care must be exercised not to go to an extreme and make the personnel uncomfortable. Many articles of comfort can be thrown overboard at the last moment or else stowed below decks.

Clear Ship for Action.—This evolution is (in time of peace) a competitive one and must be accomplished thoroughly in the shortest time. In war, ships are kept constantly cleared for action.

Again the crew work under their group leaders in each department of the ship. The heads of departments supervise the work of their groups and report when ready to the executive officer, who in turn reports to the captain that the vessel is "cleared for action."

The following duties are among those performed by the several departments of the ship:

Gunnery Department:

(*a*) Prepare torpedoes for war shots.

(*b*) Throw overboard unnecessary inflammables.

(*c*) Clear side of all obstructions to arc of fire of guns.
(*d*) Rig life lines to secure safety of men on deck.
(*e*) Fill all gun recoil cylinders.
(*f*) Test out all fire control and ship control instruments.
(*g*) Test out all gun firing electric circuits.
(*h*) Test out air-blast supply to guns.
(*i*) Lead out fire hose for putting out fires; wet down decks; plug up scuppers; lash canvas about boats carried in skids.
(*j*) Rig gun blast screens.
(*k*) Fill gun tubs.
(*l*) Provide spare parts for battery.
(*m*) Rig auxiliary means for controlling gun fire and supplying ammunition.
(*n*) Rig torpedo firing directors and test communication to torpedo rooms.
(*o*) Provide grapnels for clearing wreckage from screws.
(*p*) Secure anchors, unbend anchor chains and pay below into chain lockers.
(*q*) Put life preservers in protected place and handy to crew.
(*r*) Close all water-tight doors, hatches, scuttles, air ports not required for ready access.
(*s*) Unship and secure ventilators and ladders that interfere with arc of train or gun fire.
(*t*) Supply ammunition required to be kept in turrets or at guns.

Navigation Department:

(*a*) Rig battle signal stations, radio and flag.
(*b*) Prepare auxiliary steering and ship handling stations.
(*c*) Masthead the battle ensigns.

Engineering Department:

(*a*) Prepare for full power.
(*b*) Prepare dynamos, air compressors, and fire and bilge pumps for service.

(*c*) Throw in electric battle circuits. Throw out all electric circuits not required in action.
(*d*) Prepare auxiliary lighting arrangements.
(*e*) See handy all necessary spare engine parts.
(*f*) Shut steam not needed off all unprotected leads. Prepare to operate all boiler stops and safety valves from outside boiler compartments.
(*g*) Close all doors, hatches and scuttles not needed for access.

Construction Department:

(*a*) Aid gunnery department in work.
(*b*) Release prisoners.
(*c*) Rig repair stations; prepare collision mats.

Medical Department:

(*a*) Rig dressing stations and prepare transportation for wounded.

Pay Department:

(*a*) Serve out lunches. Haul galley fires.

The following articles are to be stowed in protected places below armor:

Navigational instruments, coaling gear, mess and galley gear, sick-bay mattresses, logs, hammocks, ditty boxes, cots, gunnery training gear, diving gear, field guns, wash deck gear, and all other gear needed in war but not used in battle.

Before action every officer and man is required to bathe and put on clean underclothes.

During war ships are kept in all respects ready for battle. It will be seen, however, that some of the above duties can be performed only when battle is imminent, such as plugging scuppers and wetting decks, securing anchors and unbending chain, closing all water-tight doors, mastheading battle ensigns, preparing for full power, hauling galley fires, etc.

The crew of fifty odd officers and a thousand men must continue to live and they must be maintained healthy and contented; therefore, a too strict requirement of dispensing with comforts cannot rigidly be enforced.

At night all battle ports are put on and the ship is maintained in complete darkness from outside. Lights that do not shine outside, needed for various purposes, are kept burning.

Having "stripped ship" and "cleared for action"; to make ready to engage in battle, the call is sounded "General Quarters."

In order to perform this important evolution methodically, at a time when men's nerves are strung to the highest pitch of excitement, the enemy being actually in sight of the advanced scouts and picket vessels, a "*Quarter Bill*" is prepared giving in necessary detail the duties of each group. The exercises at General Quarters conforming to the Quarter Bill is performed constantly in time of peace in order to insure the complete familiarity of each officer and man with his duties.

The duties as outlined in the quarter bill are under six groups.

The captain takes his station in the armored conning tower. From here he can direct the ship in battle. Through the slits provided or by means of a periscope he can see his own ships and those of the enemy. He is in telephone and voice tube communication with all important ship officers and leaders of groups.

The executive officer is the captain's relief, his duties are supervisory and if the captain is seriously wounded or killed, he takes over his duties at once.

Group I. Fire Control.—The gunnery officer is the chief of the fire control, his relief is the first lieutenant.

The quarter bill shows under this group the stations and duties of officers and men to conduct the fire control in battle under the several conditions that might arise; for instance, the determination of the initial ranges during the approach; how these ranges are to be used.

It gives the detail of officers and men by name or by small groups to important stations forming the fire control lines of communication from the spotter through the central station and sub-stations to the guns of the battery.

Also the successive fire control stations to be occupied, in case of casualties to fire control masts or the material of the fire control.

It outlines the method of controlling the gun fire of the different calibres, when firing at one target, at two targets on one side, at two targets on opposite side, on attacking destroyers during day action, at submarines during day action, at attacking destroyers at night. It describes the auxiliary methods of gun fire control, such as independent control of turrets or guns of the torpedo defense battery.

Full instructions are given for the procedure under casualties in order that every foreseen emergency may be properly met.

Group II. Armament and Ammunition.—These group duties are also under the gunnery officer and his relief. The quarter bill shows under this group the stations and duties of officers and men of the several divisions as to the methods to be used in directing, loading and firing the guns and torpedoes and the supply of ammunition. It also shows what crews are to be held in reserve; what is to be done in case of gun or torpedo casualties. It outlines the duties of the ordnance repair crews.

Group III. Ship Control.—The captain and the executive officer are the directing head of this group of duties. The quarter bill provides the methods for signalling in battle, the successive ship control stations to be occupied in case of casualties, the successive steering stations to be occupied, the methods of communication to the several parts of the ship; to the engine room, steering engine room, repair station, etc.

Group IV. Motive Machinery and Auxiliaries.—The engineer officer is the directing head of this group of duties.

The quarter bill outlines the procedure with engines, boilers and auxiliaries, casualties, reserve men, and repair crews.

Group V. Repairs.—The first lieutenant directs these duties. The quarter bill outlines the procedure in the event of fire in action, collision during battle, in emergencies such as fouling of screws, mast shot away, towing disabled ships, etc.

The repair crew during battle are held behind armor and are in communication with the captain and executive officer. The following are among the duties it may be called upon to perform: (*a*) fighting fires; (*b*) operating valves; (*c*) shoring bulkheads; (*d*) stopping leaks; (*e*) clearing wreckage from screws; (*f*) repairing electric wires shot away.

Group VI. Aid to Wounded.—The medical officer is in charge of the duties of this group. The quarter bill outlines the locations and fitting of the primary and secondary dressing stations and the details of stretcher-men. General instructions are also prepared by the Medical Corps outlining the procedure of taking care of the wounded. These instructions include a short description of first aid and its importance, routes to be used to dressing stations, materials to be at hand at each station, the stations of the medical officers and hospital corps men, method of identification of the killed, etc.

Training.—The plan of dividing the duties into groups is an excellent feature of the organization, for the reason that under it groups can be trained independently of each other.

It is evident that when the call to general quarters is sounded on the bugle and by ringing the alarm gongs throughout the ship, all the officers and men of the complement take their stations with alacrity and dispatch. However, it is impossible to keep them indefinitely at these stations if battle should be postponed many hours. It becomes necessary therefore to provide in the quarter bill for "Standing by for action," both in daylight and at night.

Ordinarily in peace times duty is stood on board ship *in three or four* watches, but in war times, if in proximity

to an enemy fleet or his torpedo-carrying vessels, a watch in two must be kept in order to provide a sufficient number of officers and men at the stations in the event of an emergency—a surprise.

The captain of the ship in all cases must be the judge as to the number of stations manned. In a fleet the admiral will usually outline a standard procedure.

Final preparations for battle are made when battle is imminent. In daylight hours the call to general quarters is the signal for final preparations. At night the guns must be cast loose and manned by the watch. The remainder of the crew will usually sleep by their guns. The call to torpedo defense quarters at night or in thick weather is an emergency call for repelling a torpedo attack and calls up the entire crew to their stations.

The quarter bill outlines and defines the duties to be performed at general quarters in action. When the call to general quarters is sounded, the crew, having been carefully trained in accordance with the quarter bill, will at once make the final preparations and take their assigned stations for battle.

At general quarters the following duties are performed: (*a*) man battery and take battle stations; (*b*) load torpedoes; (*c*) connect fire hose; (*d*) test out all gun gear; (*e*) stand by manifolds and valves; (*f*) stand by cut-out switches and switchboards; (*g*) test out all electric circuits, lighting, power and telephone.

The ship in general will receive the finishing touches to make it ready for battle and every man and officer will occupy the station assigned him in the quarter bill or by the group leaders.

In drill and also in battle, for the drill is merely a rehearsal for battle, the chief fire control officer receives the reports of " ready " from each of his groups or divisions. Ship control, radio and signal crews report to navigator. Engineering, construction, medical and pay departments report to central station.

The chief fire control, the navigator and central sta-

tion report " ready " to the executive officer. He having received all reports then reports to the captain that the ship is ready for battle.

Torpedo defense stations are manned when the call is sounded to repel torpedo attack. These stations consist of fire control parties and gun groups. The groups are located in sectors of the ship, each sector being given as near as possible an equal share of the torpedo defense guns and at least one searchlight for illuminating the target in that sector.

In day action the main battery guns only are manned and torpedo defense gun crews and their controls are kept in reserve behind armor until the call for them to take their stations is sounded.

Emergency Drills.—These drills are based on the quarter bill and watch bill.

There are four emergencies considered and provided for on board a warship. Naturally, in order that officers and men will act subconsciously, that is, without mental effort in times of sudden and nerve-straining alarm, their minds must be prepared for their individual duties through careful preparation, that is, by drills, in which the emergency is supposed to have occurred.

These emergencies are: (1) collision, (2) fire, (3) abandon ship, (4) fire and rescue.

Fire and rescue is not an emergency on board the ship, but on board another ship or ashore in the vicinity.

For these emergencies plans or " bills," as they are called, are made out, giving in as complete detail as may be necessary the duties to be performed and the manner in which the duties are divided up between the several groups.

As is known, a warship, and especially a battleship, is constructed with many water-tight compartments. To permit passage through these compartments bulkhead doors, deck hatches and scuttles are provided. These doors, hatches and scuttles are water-tight, that is when closed the bulkhead and deck are as solid and water-tight as if no doors, etc., had been cut. Most of these

doors, hatches and scuttles are opened and closed by power, usually electricity, and in case of failure of the power, by hand. All these can be closed by a single switch from the conning tower or bridge. In foggy weather and at night all doors, hatches and scuttles that conserve the water-tight integrity of the ship are closed. Officers and men can open each on the spot for use, but must close them again after the use has been completed.

Collision.—The signal for this drill, or emergency, is (*a*) sounding of the general alarm gongs, (*b*) one long blast on the steam siren, (*c*) the warning howlers, (*d*) word passed by boatswain's mate, giving location of injury.

The following duties are performed; their distribution is in accordance with the customary practice on shipboard:

(*a*) All water-tight doors, hatches, scuttles, etc., are instantly closed by throwing the electric switch in conning tower or on the bridge. Men stationed to close the doors proceed to the doors assigned, see them closed and then assemble on upper decks unless their duties demand that they remain below.

(*b*) The collision mat, a large piece of flax canvas, thrummed, with distance lines, hogging lines, dip ropes, etc., is placed over the injured plating or hole by the deck divisions (gun) in charge of gunnery officer. Divers, in diving suits, are held ready to accurately place the mat.

(*c*) Engine room starts all pumps to free water from flooded compartments.

(*d*) The location of the injury is carefully determined by the first lieutenant and carpenter. Repair party is gotten ready to close valves, shore bulkheads, etc.

(*e*) The navigator heads the ship for shoal water if in the captain's discretion there is danger of immediate sinking.

(*f*) All boats are prepared for lowering.

(g) Prisoners are released and sick made ready for *removal.*

(h) If at night, man searchlights.

In general the collision bill indicates the escapes from below to upper deck. It is important that no one be sealed up below unless his duty calls for remaining at his station for the good of the many until the last moment.

Fire.—Due to the fact that a warship carries tons and tons of explosives, the greatest care is exercised to guard against fire. Although battleships are built of steel and almost all wood has been eliminated, yet there still remain many articles which can be set on fire, such as coal, oil, sails and awnings, stores, gasoline, boats, moving-picture films, paints, etc. Strict regulations have been issued as to the stowage of inflammable articles which have tended to minimize the risk.

The signals or calls for fire quarters are: (*a*) general alarm gongs; (*b*) ship's bell, rung rapidly, followed by designated number of strokes to indicate position of fire; (*c*) bugle call; (*d*) word passed by boatswain's mates.

As the greatest danger is from explosives, the gunnery officer is directed in the fire bill to provide details for flooding magazines and shell rooms, turn on sprinkler valves which give the powder a shower bath at once, and to remove all portable explosive or inflammable articles from the vicinity of the fire.

The engineer is directed to provide details for the steam fire extinguishing and chemical fire extinguishing system. These systems are for the purpose of extinguishing fire in coal bunkers and oil tanks.

The following details are called for in the fire bill: (1) connect up fire hose; (2) put pump on the ship's fire main; (3) flood cock, magazine and store room keys served out ready for use; (4) be prepared to sprinkle and flood magazines and shell rooms; (5) remove all explosives, gasoline, oils and other inflammable material from scene of the fire; (6) cut air off from fire by closing air ports, ventilators, doors and hatches; (7) remove sick and prisoners to place of safety.

The repair crew with tools, men with hand fire extinguishers, and men with rescue breathing apparatus

assemble in vicinity of fire and await instructions from the officer in charge on the spot.

Both collision and fire at general quarters are attended to by those on the spot only. Guns engaged with the enemy should not be interrupted unless forced to cease firing by the close proximity of the fire, when they also will aid in extinguishing it.

Abandon Ship.—This emergency is one that cannot be fully performed for the simple reason that there are never sufficient boats even in time of peace, by half, to take off the entire crew.

The provision of life preservers and the safe loading of available boats must be covered by drill in order that if the emergency occurs traditional discipline of the sea will be maintained.

In battle practically no boats will be available. Those on board will doubtless be so seriously damaged as to be useless. Life preservers are kept accessible and should be served out at the last moment and the men take to the water as their ship sinks under them; firing the battery at the enemy up to the last must be considered a fundamental requirement.

Due to the large number of warships submarined during the present war, more boats are now being carried by warships. In fact, it is said the peace complement of boats is now kept on board.

Fire and Rescue.—The purpose of organization for this is in order to be instantly prepared to assist a vessel on fire, to rescue the people on board and prevent the flames, if in a crowded harbor, from spreading to other shipping. It is understood readily enough that if such an emergency were not prepared for in advance when the sudden service was needed valuable time would be consumed in organizing and equipping the party to go to the assistance of the burning ship.

The party is usually dispatched in lifeboats towed by *steamers or power* boats if the emergency should occur *in harbor.*

The boats and men are equipped appropriately.

The actual equipment includes such articles as are used to fight fires and rescue persons from fires such as: (*a*) rescue breathing apparatus; (*b*) fire extinguishers; (*c*) fire buckets; (*d*) handy billy pump and suction hose; (*e*) hose, nozzles, spanners; (*f*) tools, assorted, including tools for unshackling chain; (*g*) towing hawser; (*h*) life preservers; (*i*) hand grapnels.

The personnel of the fire and rescue parties includes an officer in charge and a medical officer, a carpenter's mate, a boatswain's mate, a blacksmith, possibly an electrician and a boatload of seamen. A gun-cotton detail may or may not be sent. Their usefulness will be to blow up dangerous derelicts or destroy buildings on fire or about to catch fire, in order to save other buildings beyond.

The station bills for fuelling, cruising, cleaning and care and preservation, berthing duty, ship's work, and liberty must all be based on the watch bill, which must be such a division of the quarter bill as will enable a ship best to meet all these demands in war as well as in peace.

The organization of a ship should be constructed on the basis of the officers and men necessary not only to fill the day battle stations and man the engines and boilers under war conditions, but in addition thereto to maintain the battery, motive machinery and auxiliaries, fire control gear and ship control gear in a condition to withstand a campaign.

The complement assigned under peace conditions may or may not meet the requirements. The peace time complement should be distributed to the ship's departments as the captain deems best; and the organization will carry vacant stations in case the complement does not meet the war-time requirements.

CHAPTER XXV

TRAINING OF A WARSHIP FOR BATTLE

It has been explained that the several groups of men on board a warship require group training before they can be trained coördinately. The methods employed will now be described as briefly as possible for a general understanding by the reader. It is natural that some of these methods are guarded as secrets, yet there seems at this time no real reason for secrecy, inasmuch as most of our methods have been borrowed from the older navy of Great Britain and are in use by almost all the navies of the world.

Engineering Department.—After organizing, the engineering department must become familiar with their "lay-out." In the engineering department are machinists, oilers, electricians, water tenders, boilermakers, blacksmiths, coppersmiths, firemen and coal passers. Each has his distinct trade. Promotion is possible for every man who shows himself capable and willing to learn higher duties than those of his rating.

In the fire rooms, the life-giving power to the ship, for without steam there can be no motion, are stationed:

(*a*) *Water tenders,* who are entrusted with the proper steaming of the boilers. They see that the safe level of the water is maintained. Low water in a modern boiler, which means that the water tubes in contact with the flames are dry, is a most dangerous state of affairs, and will cause the melting of tubes and partial explosion of the boiler. The feed pumps, therefore, are carefully tended. The water tenders are in general charge of the steaming of the boilers and direct the firemen accordingly.

It has been found that the systematic firing of the furnaces of boilers promotes efficiency. Only one furnace of a boiler is fired at a time. An electric signal system *has been devised* where a bell signal is given periodically

in each of the many fire rooms which will tell the men when to fire each furnace.

(*b*) *Firemen* who do the actual firing and cleaning of the fires in the furnaces. With oil-burning boilers the firemen regulate the burner valves, the oil heaters, oil pumps, forced draft blowers, etc.

(*c*) *Coal passers* who supply the coal from the bunkers and heap it on the floor plates near the furnace for the firemen to fire into the boilers.

It has been found by an analysis of the products of combustion which go up the smokestacks that better efficiency in raising steam on an equal amount of fuel is attained when the constituency of the gases is in a certain proportion of carbon and oxygen and that then there is practically no smoke. By this analysis, therefore, and by watching the smoke, the air supply and coal or oil supply can be regulated to give the best results. It is of great advantage not to make smoke, for the reason that smoke seriously interferes with the sighting of the guns and furthermore gives a telltale indication of a fleet's location to an enemy scout many miles distant.

Engines in modern warships are both reciprocating engines and turbines. In the very latest to be constructed the engines are to be "electric drive." However, the several types are to be described later. Submarines are surface propelled by oil engines.

The greatest care of machinery is required from the personnel; especially is this true of auxiliary machinery, including pumps, evaporators and distillers, oil pumps for lubrication, condensers. Frequent overhauling of reciprocating engines must be accomplished; with turbines much less care is needed.

In getting up steam, all steam piping must be warmed slowly, otherwise serious accidents are likely. The engines, too, must be warmed evenly and slowly to avoid *unequal expansion* and the blowing out of packing.

As fresh water must be husbanded carefully every *steam leak* is sought and stopped. The ship's distillers

and evaporators should make sufficient fresh water for all purposes, but their capacity is naturally limited.

The dynamos, also, are run by the engineering department. Almost all power outside of the engine rooms and fire rooms is electric—turret training and elevating motors, ammunition hoist motors, ventilating motors, motors for boat cranes and deck winches, motor for radio, anchor engine motors, etc.

Gunnery Department.—Next in importance to be able to steam capably is to shoot rapidly and straight. Gunnery is put after steaming, for the reason that the guns must be able to arrive in order to be used.

The gunnery officer supervises the drilling of his department.

The drilling of gun crews is naturally the first task to perform. The fire control is of no value until the guns can be loaded quickly and fired accurately.

The division officers act as instructors, aided by petty officers with long experience in the navy. These petty officers usually hold the ratings of turret captains and gun captains. For the technical instructions to the gun crews, such ratings as gunner's mates and electricians are utilized. These rated men are all of exceptional ability and intelligence in their specialties and often make better instructors than the young officers, for they are closer to the recruit in methods of thought and have themselves been through the mill.

In general, the duty of a drill officer or petty officer is to impart to the gun crew a sound knowledge of the gun, mount and the practical results to be accomplished by drill.

Give the men under training the framework, the salient points; the details will come later, when they become more familiar with the gun. Much of the details will be observed by the men subconsciously.

No part of the drill should be performed without an *explanation as to its necessity. The intelligent man likes to know why things are done as they are.*

Impress upon the men the absolute necessity for rapid and accurate fire. Once they have grasped this necessity it will be easy to arouse in them enthusiasm to develop the fine points in loading, sight-setting and pointing.

Explanations and instructions should be made concise and clear. Drills should be always short and snappy. The instructor must be vigilant to catch a lack of interest in the drill by his men. It is then time to stop the drill for the day. When making an explanation the attention of the entire crew should be demanded; even those who may understand should be required to observe "silence" and attend.

In assigning men to stations physical condition must be considered. Large muscular men are given duties to absorb their greater energy and physical endurance. Small but active men in the same way are given stations requiring agility but not great strength.

Commands at gun drill must be given in a clear and distinct manner. There must be no misunderstanding, which might cause confusion and disorder. "Order contra-order, disorder," must be avoided.

The following commands are standard at great gun drill in the navy:

1. **Stations:** The crew go to their stations and await the next command. The gun is supposed to be ready for action.
2. **Load!** The crew go through the operation of loading the gun.
3. **Commence Firing!** This command may be given either before or after the gun is loaded. If before, the gun is loaded at once. The target having been designated, when the gun is loaded, the gun is pointed and fired and again loaded without further commands. The firing and loading continue uninterruptedly.
4. **Silence!** This command is given to stop the service of the gun. Every member of the crew ceases all operations and awaits in silence for instructions to follow. Any member of the crew observing something wrong, which might endanger material or life, shall command "silence" and inform the Division Officer what he has observed.
5. **Carry On!** After instructions have been given or defect *remedied, this* order is given, at which crew resumes opera*tions.*

6. **Cease Firing!** The service of the gun is stopped, and steps are taken so that gun cannot be fired—usually break electric firing circuit at contact lug in case of big guns. Small guns remove cartridge case.
7. **Unload!** Remove the powder from the great gun.
8. **Secure!** Return ammunition to magazine, secure the gun, returning all accessories to their usual places of stowage. Wash out gun, dry and oil.

In time of war all guns are kept ready for instant use. Training and elevating gear is frequently tested. If tompions are used they must be made to haul out from the breech. Except in especially bad weather turret turnbuckles are left off, centring pins out, wedges released, water sheds raised and port shutters not in place. All necessary spare parts and tools are kept at hand. Firing circuits connected up and periodically tested out. Air-expelling device tested.

All ammunition should have been overhauled and carefully measured to see that none is too large to enter the gun. All accessories for the service of the gun are constantly kept in place and sights adjusted. At drill all of the above duties must be performed.

Loading.—Rapidity of loading depends upon the expertness of the gun crew. Precision is necessary. Each member of the crew must perform his task just at the right time and just in the right way. Team work, in other words, will develop accuracy and rapidity.

Accuracy must be insisted upon. A single mistake caused by inaccuracy or carelessness may cause exasperating delays. Overanxiousness is dangerous. "More haste the less speed" aptly applies to loading of guns. A broken powder bag may cause the gun to cease firing for a considerable time at a critical moment in action

In loading a gun, turret or broadside, the less movement required of the crew the less apt is confusion to occur. A division officer should aim to make his gun crew act with the precision of a well-designed machine. Perfect *the individual* movements one at a time, then when *the whole machine* is started it should run smoothly and

with a minimum of confusion and interference. If all parts of an engine are accurately made, according to design, when assembled, it will run smoothly.

The amount of drill required for expertness depends in a great measure upon the amount of interest stimulated. The stop-watch is an excellent stimulant. A noted expert on scientific management was invited to enter a modern turret on board one of our dreadnoughts and witness a drill at the turret guns, with the idea of suggesting how the drill could be improved. After the drill he enthusiastically said: "That was the finest example of scientific management I have ever witnessed. We speak in the industrial world of saving minutes; you deal in fractions of seconds."

The following general rules should be observed in loading guns:

1. After a gun using smokeless powder has been fired, there remains in the bore of the gun an oily gray smoke. This is an inflammable gas heated to a temperature just below its flash point. If this gas is mixed with oxygen and then comes in contact with a spark or an incandescent particle of powder bag or other incandescent matter it will burn with a considerable degree of heat. If the wind should be blowing into the muzzle of the gun, then this gas may be forced through the breech when the breech-plug is opened, and if there is present in the screw-box or on the mushroom face of the plug a piece of incandescent matter, the gas will at once burn inside the turret, endangering any powder which may be at that locality. For this reason gas-expelling devices are used to blow this dangerous gas out through the muzzle before the breech plug is opened. The ignition of this gas inside a turret has been termed a "flare-back."

When the plug is opened a member of the gun's crew looks through the gun. When he sees there is no smoke in the bore, or when he sees daylight through the bore, he knows the dangerous gas has been expelled. He then reports "bore clear."

2. The shell should be carefully seated, otherwise the gas of explosion will leak past the shell and the velocity of the shell will be materially reduced. The bore of the gun is rifled; that is, ribs are cut to give the shell a twist as it passes from the breech to the muzzle. Near the base of the shell is shrunk a copper rifling band. When the shell is "rammed home" the rifling band comes in contact with the rifling in the gun, the soft copper permits the steel rifling to bite into it. This is called seating the shell.

3. In every powder bag, on the rear end, are several pounds of black powder, called the ignition charge. This end of the powder bag is marked in "red." Care must be exercised to be sure that the red end is always to the rear next the primer, otherwise a miss-fire or a hang-fire will result.

This black powder is, as its name implies, for the purpose of insuring the ignition of the smokeless powder, which is more difficult to ignite.

4. Guns using power bags have a firing lock in the breech of the gun in which is inserted what is called a "primer." Depending upon the gun, precaution must be exercised in inserting the primer. In some guns the breech must be closed and locked before the primer is inserted. In the latest guns the danger from premature ignition of the primer while the breech is opened has been taken care of in the design.

5. The loading tray is a metal or wooden tray which fits over the screw box and makes a smooth path for the shell and powder on entering. It protects the screw threads and gas check seat from being injured by the highly hardened points of the shells and prevents the powder bags from being broken as they are rammed into the powder chamber across the screw box.

6. The greatest care must be taken to see that the ammunition will fit the gun when loaded. Sometimes a small piece of waste sticking to the shell may prevent it *from being* "seated."

7. *After* every shot with a gun using powder ba

the mushroom face must be wiped off with a wet sponge. This mushroom becomes very hot and after very rapid fire might have very hot, even incandescent, particles of carbon adhering to it, from which there exists danger of igniting the powder before the breech is locked, thereby causing a serious premature discharge of the gun.

8. In guns using brass cartridge cases great care must be exercised to see that point of firing pin is "housed" when closing the breech. A member of the gun crew assures himself of this by passing his hand across the breech face before closing the breech on the charge.

9. Inasmuch as rapid loading demands a rapid supply of ammunition from the magazines to the guns the supply of ammunition is made a feature in the drills to insure an adequate amount.

10. If the gun should be elevated, especially at extreme elevations, and on the first load, when the bore of the gun is well oiled, there is likelihood of slipping of the projectile, even after it has been seated. To prevent this tie a small grommet of twine around the shell just forward of the rifling band.

To know if a shell is seated properly is one of the duties of a shellman or rammerman. A trained ear will know at once, for a properly seated shell emits an unmistakable, clear, metallic, ringing sound, while a shell not seated gives a dull thud.

11. It sometimes happens that the vent fouls. The vent is the opening through the mushroom by which the ignited powder from the primer passes into the powder chamber of the gun. To clear it a priming wire is supplied. If it cannot be cleared with the priming wire the vent drill is used.

12. Never keep a primer that has once been fired in the turret. It has happened that gun captains have stuck empty primers in their primer boxes and at target practice have loaded the lock with a "dead" primer. The result has been delay and a poor score.

Turret Gun Drills.—A turret usually has two guns, divided by a flame-proof partition. In the latest ships of the " Pennsylvania " class there are three guns in each of the turrets.

The turret officer controls all the guns of his turret, and as far as possible the handling room's crew.

The following general rules are laid down to guide the turret officers:

1. Turret officer: Takes station in booth in rear of guns or where he can best exercise his command of the turret.

2. Junior officers: Three officers should be in a turret crew—one stationed in handling room and one for each gun of the turret. It is, however, the custom to have one gun commanded by a turret captain.

3. Turret captain: The turret captain is usually put in charge of one gun and a junior commissioned officer of the other. The turret captain should not have a station that will prevent him from observing the operation of his turret as a whole, therefore he should not be given charge of a gun.

4. Gunner's mates: They form the repair party of a turret. They are not given stations in the gun's crew. They should be expert in making repairs to the guns.

5. Turret electricians: They have charge of electrical installation in turrets and are stationed in turret during drills, target practice and battle.

6. Gun captain: At each gun there should be selected a man recognized to be a leader of men. He must know the gun and mount, be alert, and of keen judgment.

7. Pointers and sight-setters: Every turret gun must have two pointers—one acts as sight-setter for the other. The pointer controls the gun in elevation and fires it.

8. Trainer and sight-setter: Every turret gun must have two trainers—one acts as sight-setter for the other. The trainer controls the turret laterally.

9. *Messengers:* There is a messenger in the turret and *one in the handling* room. They are used to convey

messages inappropriate to send over the fire control telephones.

10. The handling room is the space at the bottom of a turret. Magazines and shell rooms usually open directly into the handling rooms. The ammunition is placed in the ammunition cars which are then hoisted up to the turret.

The men composing turret guns' crews or turret crews have been given titles:

Titles	Duty
(1) Plugman	One who operates the breech plug;
(2) Hoistman	One who operates a hoist, in two stage turrets preceded by word *upper* or *lower*.
(3) Rammerman	One who operates a rammer either hand or power.
(4) Trayman	One whose primary duty is to put in and take out the loading tray.
(5) Shellman	One whose primary duty is to handle shell.
(6) Powderman	One whose primary duty is to handle powder.
(7) Signalman	One whose primary duty is to operate signals or indicators between turret and handling room.
(8) Carman	One whose primary duty is to see that powder is gotten clear of the car; that is, that doors are opened and closed and levers tripped promptly.

Each member of a turret's crew must thoroughly know his own station. He should also know as many other stations as possible. The man who knows all the stations is usually better able to fill one than one who only knows the station he is filling—this is fundamental.

The method of drilling a turret's crew resembles in principle the training of a football team.

The men are picked by the turret officers for their stations. The gear is explained to them and operated for them. The general scheme of loading is shown them and the necessity for precision and safety regulations impressed upon them. Then each individual is drilled in his special duties until he is proficient.

The turret officer and his assistants study carefully the movements of each individual man. The object is to obtain the best, surest and quickest method of accomplishing each individual duty.

Precision must be considered more important than speed.

Due to the great difference in the arrangement of turrets, it is difficult to outline a turret drill that will fit all turrets, but some idea is necessary of a drill to completely understand the subject. A drill, using ammunition hoists, cars holding both shell and powder, is used as an example.

The crew, being at their stations, at the command Load! gun in loading position.

(1) The plugman opens the breech of the gun and swings it clear.

(2) The rammerman, from in rear, looks through the bore and calls "bore clear."

(3) The signalman signals handling room to stand clear of loaded car; this is done instantly at command "Load!"

(4) The hoistman brings up the loaded car containing the ammunition to a position just under the gun and when signal "bore clear" to a position in rear of gun for loading.

(5) The carman sees doors open or latches tripped.

(6) The trayman puts loading tray in breech.

(7) The rammerman rams home the shell.

(8) The powderman puts powder bags in front of rammer when withdrawn; two bags at a time.

(9) The rammerman rams home powder—in two motions.

(10) The signalman indicates that car is about to return to handling room.

(11) Hoistman lowers the car to handling room.

(12) The trayman takes out loading tray.

(13) The plugman closes the breech, keeping *circuit contacts* just open—circuit broken.

(14) The gun captain puts primer in lock.

(15) The plugman completely closes breech.

(16) The gun captain calls "Ready Right" or "Left," whichever gun is being loaded.

(17) The gun pointer brings gunsight on target and fires, then brings gun to the loading position.

The above duties must be performed in the order given, otherwise casualty and confusion will result.

For example, if rammerman fails to call "bore clear," the hoistman will not bring his car to the loading position. If signalman does not signal to handling room to stand clear of car an accident to personnel in handling room may result. If trayman does not put loading tray properly in breech the nose of the shell will fall into the screw box, damaging it and delaying the loading. It can be seen that each movement must be carefully timed and that a single slip may ruin the loading. There is a reason for every step carefully worked out by the young naval officers and their enthusiastic enlisted men.

It may have been noticed that in the drill given above the shellman was not used. That is because the shell does not require handling in the turret layout described. In turrets where the shell is handled and placed in the loading position in front of the rammer, the shellman has a place.

In many turrets in our navy powder is passed up from the handling room by hand. This requires strenuous drill. Each bag weighs about 50 pounds for the 12-inch guns and a man must lift this several feet almost every five seconds. Power powder hoisting is again coming into favor.

Pointers.—It matters not how rapidly a gun crew can load if the pointer cannot hit the target. "The only shots that count are the shots that hit."

The pointers, therefore, are carefully trained—in the first place pointers are selected from among the most *intelligent men* of good eyesight.

A pointer is taught the principles of fire control and *above all of* the necessity of firing only when his cross-

wires are on the target. He is consistently drilled and always eliminated if he shows he is incapable.

The training of gun-pointers, gun-trainers and sight-setters is carried on at times independent of the loading of the gun.

The training of a turret gun's crew has been described at some length for the reason that the turret guns are the most important guns carried, and a knowledge of this drill is essential to a man-of-war's-man.

Another gun of some prominence, it being the gun adopted, at present at least, as the anti-torpedo gun of our latest commissioned battleships, is the 5-inch 51 calibre rapid-firing gun.

A rapid-fire or rapid-firing gun is one that uses "fixed" ammunition or the powder is fitted into brass cartridges.

DRILL OF 5-INCH 51 CALIBRE R. F. GUN.

Titles	Stations
Plugman (gun captain)	At operating lever of breech mechanism.
Pointer	At gun elevating wheel.
Trainer	At gun training wheel.
Sight setter	At sight hand wheels for setting sight in range and deflection.
1st shellman	Left and rear of breech of gun.
2nd shellman	To pass shell to 1st shellman.
1st powderman	Left and rear of breech of gun.
2nd powderman	Right and rear of breech of gun.
3rd powderman	To pass powder to 1st powderman.

COMMANDS

1. **Stations:** Crew to stations as shown above, preparatory to serving the gun.
2. **Load!** (The gun having been fired.) Pointer and trainer keep the crossfires of their sight telescopes on the target.

Sight setter sets sights as ordered by the fire control.

Plugman opens breech of gun; sees cotter pin in place; feels face of plug to see firing pin is "housed."

1st shellman puts in shell and attempts to seat it by giving it a quick shove, following through; gets a second shell from 2nd shellman.

1st powderman puts in brass case and gets a second one from 3rd powderman.

Plugman *closes* breech of gun and calls out "Ready."

2nd powderman takes stand in rear of gun to catch empty *cartridge* case when gun is fired.

Other shellmen and powdermen provide shell and powder to 1st shellman and 1st powderman.

3. **Commence Firing!** This command may be given either before or after the gun is loaded. If given before, the gun is loaded at once.

   The firing and service of the gun are started. The pointer fires on the firing signal or when on the target, depending upon nature of the practice.

   The gun is reloaded as soon as fired, and firing continues until the ammunition is exhausted or until the command "Cease firing!"
4. **Cease Firing!** The service of the gun is stopped. If the gun is loaded, the plugman opens breech; 2nd powderman withdraws brass case.
5. **Unload!** This command may be given after the command "Cease firing!" in which case only the shell remains to be removed, or it may be given after the gun is loaded and before the command "Commence firing!" In the latter case plugman opens breech of gun; 2nd powderman withdraws brass case; 1st shellman withdraws shell. (It may be necessary to ram shell out from the muzzle of the gun.)
6. **Secure!** The members of the gun crew return everything that has been provided and secure the gun, under the supervision of the gun captain. If the gun has been fired the crew assists the gunner's mate in washing out and oiling the bore. Crew fall in for muster.

The basic principle involved in gunnery training is to acquire the ability to hit the enemy more times than he can hit you. This object must be sought in all conditions of sea, wind, atmosphere and light. It is, of course, the highest duty of an admiral to so place his fleet with respect to an enemy fleet that the advantage of wind, sea and light lies with his gunners and against those of the enemy. To put a handicap upon his own gunners may be the result of bad tactics or inferior manœuvring qualities. It may be the fault of the admiral's judgment or it may be the outcome of bad judgment in the design of the ships of the fleet.. A nation that builds warships with manœuvring qualities among which are speed inferior to those of a possible antagonist, is truly in need of the best naval tacticians to fight the nation's battles.

In the consideration of rapid hitting let us consider *two battleships,* similar in gun-power; each carries ten *14-inch guns.* One ship, call it "A," through careful gun-

nery training, reaches such a high standard of gunnery efficiency that under exactly similar conditions at target practice and in the same time of firing makes twice the number of hits that " B " makes. In battle then "A " would be worth to the Commander-in-Chief two ships of the efficiency of " B." It will thus be seen how very important gunnery training is to a fleet.

In gunnery training the first step is to instruct the men in their duties. Then, to train the gun crews to perform their duty accurately, yet swiftly. Every second must be accounted for.

The battleship endeavors to station as gun-pointers only those men who have " proved " to be good and reliable shots.

The Navy Department has clung to a policy of secrecy in regard to the several methods of training men to shoot the guns. It is also inadmissible to describe the methods of controlling the fire of guns and batteries on board our ships. Those who will serve as volunteers in the navy will become familiar with these secrets only after joining their ships. The methods are simple enough and quite within the mental grasp of the majority of our recruits. The instruments used are fairly complicated and their development has been the result of much experience and study by officers of the navy in collaboration with commercial firms, principally electrical.

The details of target practices and engineering competitions to bring the warships of our navy to a high state of battle efficiency are likewise kept confidential. It is regretted that these cannot be explained in this volume.

CHAPTER XXVI

THE TRAINING OF THE FLEET FOR WAR

THE training of a fleet for war naturally comprises many things. In the first place each vessel first must be trained in order that it can perform effectively its special duty and fit in to the place given it in the war plan of the Commander-in-Chief. Each vessel must:

1. *Perfect the Organization.*—This means that the organization of the personnel must be such as to conduce efficiency in all departments of the ship. The organization must be founded upon principle and be knit into unity by a thorough coördination of ideas and intentions. There must be no part of the organization lacking, and the personnel must be adequate in numbers and intelligence to perform the duty assigned it. Good organization implies discipline among the officers and men of the ship. Discipline is the most important attribute of a well-organized crew. Its possession means that both officers and men thoroughly understand their place in the organization and the obligation expected of them. Discipline is the principle of life; it achieves coördination, engenders mutual respect for the work of others, promotes contentment and arouses pride in the individual at being a part of the organization.

2. *Thoroughly Train the Personnel in the Use of the Material.*—Once the organization is completed and officers and men have been grouped in accordance with their understanding and capabilities, training completes the organization's effectiveness. Training makes a unit of a ship that before was merely an assemblage of parts. Group training must necessarily precede the higher training. Each ship upon going into commission, either as a new ship, or an old one after an overhaul, receives its allowed complement of officers and men. This complement includes all ranks and ratings, professions and

trades required to properly control the numerous and complicated machinery and the turrets and guns, to care for the hull and fixtures, and to provide men for the numerous activities required to control the ship under way in manœuvres, in target practice or in battle.

These ranks and ratings find themselves assigned duties appropriate to their capabilities, and having been inoculated with the discipline virus set loyally to work studying their individual tasks. Group training is the basic, bed rock foundation, requirement of all higher training. This training must be as near perfection as possible, for upon its excellence depends the value of the ship as a unit of the fleet.

Group training is usually perfected by a ship before it joins with other ships, that is while it is alone or during what is termed in the navy "shaking down." It includes a thorough training of men of the Engineer Department in firing boilers, water tending in boilers, handling of fuel, running auxiliary machinery, handling and caring for main engines, the running of the entire electric plant, including radio, gyro compass, power motors of all descriptions; of the deck divisions in handling the machinery of turrets, the mechanism of guns, the supply of ammunition, the fire control instruments, the signal material, the boats of the ship, the ground tackle (anchors and chain cables). In fact, as has been said above, each function must be studied and its individual application perfected before it is possible to begin the training of the ship as a unit.

For purposes of training a competitive feature is introduced for these groups, in order to increase the efficiency of all similar groups in the fleet. Certain performances are required of each ship. This makes possible a comparison of the efficiency of the engineer's department of vessels of the fleet. To achieve success the engineer officer must coördinate all his groups, those handling the *boilers, those handling* the engines, and those handling *the auxiliaries.* In the same way target practices are he

for the double purpose of training and comparing the efficiency of the gunnery departments on each ship.

3. *The Training of the Ship as a Fighting Unit.*—After the groups have been trained separately, the next step is to train the groups coördinately. To compare the results of this training, competitive target practices are held at which the ships simulate actual battle conditions.

4. *The Training of a Group of Ships.*—After the single units have become expert then ships are assembled into groups. The group training of ships is for the same purpose and as important as the group training of individuals. Groups of ships are trained to manœuvre together by signal, to pass from one formation to another with ease and safety, at first at moderate speeds and afterwards at highest speed.

5. *The Training of Larger Groups.*—The smaller groups are concentrated into larger groups and are trained in manœuvring. These drills perfect the ship control facilities of the higher officers, give expertness to the signal force and produce care and confidence in the personnel for handling many ships in close formation at high speeds.

6. *The Taining of Groups of Different Types in Coordinate Exercises.*—This is accomplished in what is called strategical and tactical manœuvres or exercises. The fleet, consisting of all types, is divided up between two leaders. A definite problem is given each leader. The problem is so designed as to produce a situation which might be probable in war. The two fleets are each instructed to execute the problem, to decide their objective and dispose their ships according to their own plans. The entire course of the manœuvre is plotted and afterwards discussed by a competent authority, most appropriately the Commander-in-Chief himself; the faults and mistakes are brought out clearly before the contestants and all endeavor to profit by their failures.

The above description refers mostly to battleships and cruisers, the vessels that form the line of battle. The

auxiliary types of which a fleet is composed must also be put through a course of training. These types are usually trained separately from the big ships. Their training is in a great measure intrusted to the officer selected to command all of the type in the fleet.

The Training of a Destroyer.—Our destroyers are of from 700 to 1000 tons displacement. They are weatherly, fine sea-going types, and have a maximum speed of about 30 knots, or nearly 35 miles an hour. They are armed with a battery of 4-inch guns and carry four twin torpedo tubes and eight long-range torpedoes. All are oil burning and have turbine machinery for motive power, with a radius of action such that they could duplicate the recent feat of U-53, by steaming to Europe and return without refueling.

In the training of a destroyer there are many things to consider, among them (1) organization, (2) steaming, (3) gun fire, (4) torpedo fire.

In war the organization must consider (2), (3) and (4) as interdependent activities. Each must be developed to the highest efficiency.

The duty of the destroyer in war is to attack with the torpedo the enemy battleships. The attack to be made both in daytime and in darkness. High sustained speed is essential for this vital duty.

The enemy cannot be accurately located. Information as to its location which comes to the destroyer force will be in error, probably many miles. It therefore becomes necessary for the destroyers aiming to attack *at night* to search for that fleet.

For *day attack* the destroyers must gain a position of advantage on the bow of the enemy fleet and so time their movements as to attack while enemy fleet is under fire from the batteries of our own battleships.

Training to develop proficiency in all of the above services is necessary.

By organization is meant the proper preparation of *station bills giving* a complete outline of all the duties *required. This* is the first step in training.

"Steaming training" is done by using the boilers and engines at various speeds.

The gun training is carried on similarly to that done on board the big ships.

Torpedo firing, the most important function of the destroyer, absorbs much of their training period. Upon the efficiency of this weapon the value of the destroyer depends.

The torpedo is a very expensive weapon, each costing from five to seven thousand dollars; it may be seen that a navy could hardly afford to expend in such wholesale manner a vast number of torpedoes for the purpose of drilling the men who will fire them in battle. That the men must be trained and the torpedo run is quite necessary and to do this without loss is an everyday occurrence on board a destroyer.

Instead of the war head containing high explosives, a practice head similar in weight and size is fitted; secured within a cavity in this head is a calcium phosphide torch. Now we can fire the torpedo exactly as would be done in war, and the torpedo after expending all its air will rise to the surface of the water and there float, giving off smoke in the daytime and a bright calcium flame at night, to show the destroyer where it is located. The process of getting a torpedo ready for firing is to torpedo men an everyday occurrence. The torpedo air flask is charged with air at 2250 pounds pressure. This air leads through a stop valve to the engine of the torpedo. This engine is capable of making a great number of revolutions per minute, driving two propeller shafts and giving to the torpedo a high speed.

After all the adjustments have been made, which are many, and each is vital to the success of the run, the torpedo is loaded into the tube and the tube door closed upon it. Then a powder charge is inserted in a receptacle and the firing mechanism cocked ready for ejecting the torpedo from the tube into the water. The tube is now trained in the true direction to fire.

Now let us suppose the torpedo is ready for its run and in the tube; the pointer in his seat on top of the tube is prepared to train on the target when it becomes visible. The destroyer at full speed steams to the attack. The gun-pointer, using his training wheel, quickly aims, and when his cross-wires are on, pushes his key. The powder impulse charge explodes, a pressure of about 50 pounds per square inch is put upon the rear end of the torpedo, which forces it through the open end of the tube at a rate of about *thirty-five feet per second.* As it leaves the tube the starting valve of the torpedo is opened and the engine begins to turn over. When the torpedo takes the water in a long flat dive the throttle automatically opens wide and at from 27 to 35 knots speed the torpedo starts truly in the directly fired. To maintain the direction straight a gyroscopic steering gear is installed which prevents a deviation from the straight path.

When the torpedo has ended its run a thin curl of white smoke can be seen on the water; the destroyer goes near and lowers a boat which pulls for the torpedo, secures its lines to it and pulls back to the ship where the torpedo crews receive it, hoisting it aboard to get it ready for another shot.

After the destroyer is proficient in steaming, firing its guns and torpedoes, the officer in command of all the destroyers must develop the expertness of his force in attacking. This is done by outlining progressive manœuvres to be carried out. First groups of destroyers are trained to operate in company, both in daytime, in fog, and at night, and without lights. This training has its elements of danger and not infrequently collisions have occurred, but they are all in the day's work. When the fleet finally assembles the Commander-in-Chief desires the destroyer force to be fully trained and ready to act coördinately with the battleships, scouts and auxiliaries of other types in war manœuvres.

***The Training* of a Submarine.**—This type of warship *must* receive the most careful training, in fact, the

machinery installed is so intricate that it has been found necessary to give the submarine personnel special courses of study and training. The main reason for this individual treatment of the submarine is due to the especially hazardous service. An accident to a surface vessel such as a destroyer is hazardous to a part of the personnel, but an accident to a submarine while submerged in deep water may cause the loss of the vessel with "all hands."

The training of the submarine may be divided into:

1. Training in submerged work.
2. Firing of torpedoes.
3. Firing of guns.
4. Training in attack.

The training in submerged work is of primary importance. The submarine must learn to dive quickly. To run with a minimum of periscope showing. To steer accurately under water, both horizontally and vertically. As many of the personnel as possible must be trained at all important stations, thereby minimizing the effect of casualties in the crews. While training submerged, the crew are instructed in the casualty drills in order that they will be ready to meet a sudden emergency. These emergency drills are practiced frequently.

The firing of torpedoes is done while submerged. The method is similar to that used by destroyers. The torpedo is aimed by means of the periscope. The calcium, in practice, effects its return to the submarine.

Lately guns are being mounted in submarines for the sole purpose of self-protection against surface craft. A submarine is expected to defend itself by diving, yet if there is not sufficient time and the enemy is not too stoutly armed, the submarine's guns may save it from destruction. The training is similar to that done on other vessels with guns, but as the gun and mount "house" in the hull, bringing the gun up to the firing position is a feature of the training.

In the final training of the submarine, through which expertness in attacking a warship is sought, surface ves-

sels are used and the submarines either singly or in groups are taught the simple rules of approach.

When a submarine sights smoke which may be that of an enemy vessel, it must at once sink down until only a part of its conning tower is showing. Discovery is fatal to a submarine, for an enemy usually can escape it if he sights the submarine outside of torpedo range. The submarine is thus in what is called the "awash" condition, using its Diesel engines; it steams to intercept the smoke. When the hull of the vessel sighted is made out the submarine should submerge to escape detection and then running on storage batteries and motors continue its course to intercept its target.

By maintaining an enemy on a constant compass bearing the submarine is certain to intercept. If the enemy draws rapidly ahead of a constant compass bearing, then the enemy's speed is so great in comparison to that of the submarine that intercepting is impossible.

Maintaining the enemy then on a constant bearing, the submarine will remain entirely under water, "porpoising" or coming to the surface at intervals to insure that the proper bearing is being maintained. When within torpedo range the submarine, having assured itself of the hostile character of the vessel approached, fires its torpedoes.

During the approach by plotting the position of the submarine and also the bearing and distance of the target, the speed and course of the target can be fairly accurately obtained. This is used in setting the periscope, the torpedo-firing sight.

The Training of Aeroplanes.—This training consists of (*a*) training the personnel to fly the machines; (*b*) training the personnel to use machine guns, bomb guns, or other offensive weapons carried; (*c*) training observers.

In view of the fact that there are but few naval aeroplanes in service, the actual training required to work in the fleet has not been definitely outlined.

PART IV

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CHAPTER XXVII

SEAMANSHIP

An effort to cover the field of seamanship in one chapter could hardly permit more than a mention of the many activities which go to make up the life of a sailor. Having in mind, however, those who may desire to know some few of the most important parts of the sailor's profession, in order that they may have a fuller appreciation of its intricacies and the width of field embraced by it, this chapter has been attempted. For a complete understanding of the subject "Modern Seamanship"—Knight, and "Deck and Boat Book of the U. S. Navy" should be studied.

The mere mention of the name seamanship naturally brings to mind "knotting and splicing." This art is quite as important on board ship to-day as it was in the days of sails, although the volume of such work has materially decreased.

Rope is the material used in knotting and splicing, and in our navy ropes are of hemp, manila and wire. Hemp rope is made from the fibre of the hemp plant. Manila rope is made from the fibre of the stalk of the wild banana tree.

Hemp rope finds its principal service in standing rigging and is usually tarred to protect it from the weather. Manila rope is used mostly for running rigging due to its flexibility in rendering through blocks.

Both manila and wire are used for hawsers. Wire is much stronger but also heavier and more difficult to handle. Coir rope made from fibre of cocoanut husks is frequently used by the merchant service for towing hawsers; it is very buoyant but has only about one-fourth *the strength* of the same size manila rope.

Hemp and manila rope are made up from "yarns" of the fibre; these are twisted into strands and the strands into rope. Then ropes are further twisted into cables. Wire is similarly treated. A hemp core is used in making wire rope from "yarns" and "strands" of wire in order to give it flexibility.

Rope is designated in size by its circumference in inches.

STRENGTH OF ROPE AND HAWSERS

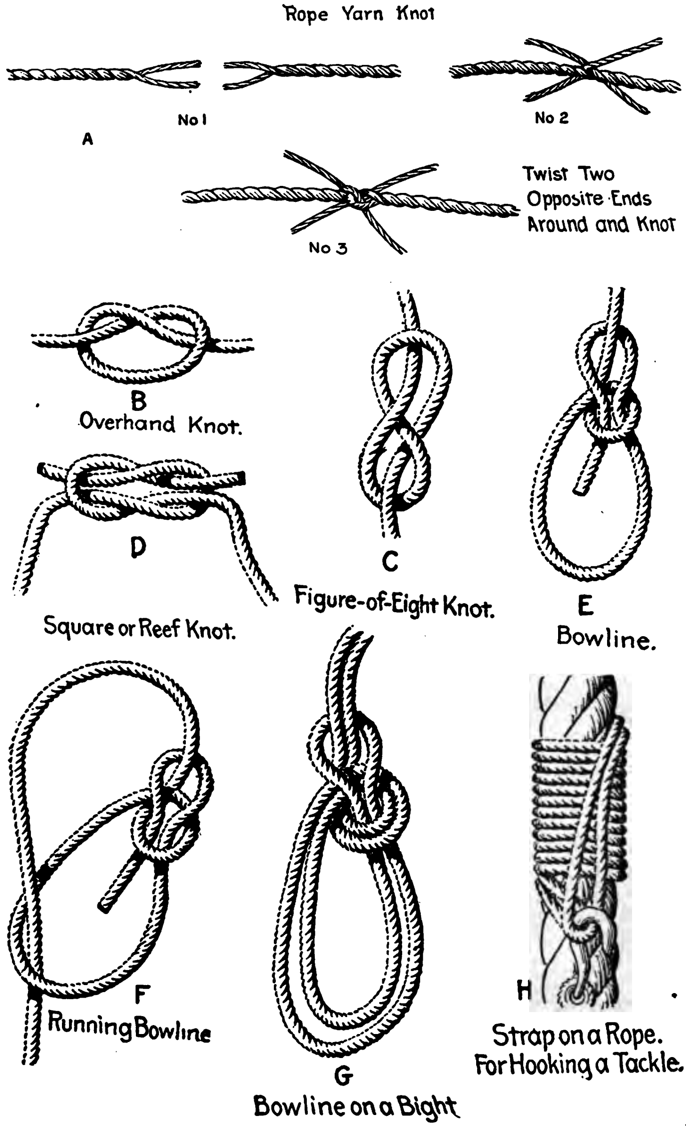
Circumference in inches	Safe working load in pounds		
	Manila	Wire	
		Inflexible	Flexible
1	180	1000	730
1-½	400	2300	1750
2	650	4000	3000
2-½	850	6300	4800
3	1300	9200	7000
3-½	1700	12500	9300
4	2240	16500	12500
4-½	2900	18300	15500
5	3600	25000	20000
6	4500	36500	28000
7	6000		
8	7800		

Knots.—Every man who expects to render service on board ship should have some knowledge of marlin spike seamanship; that is, knotting, splicing and seizing.

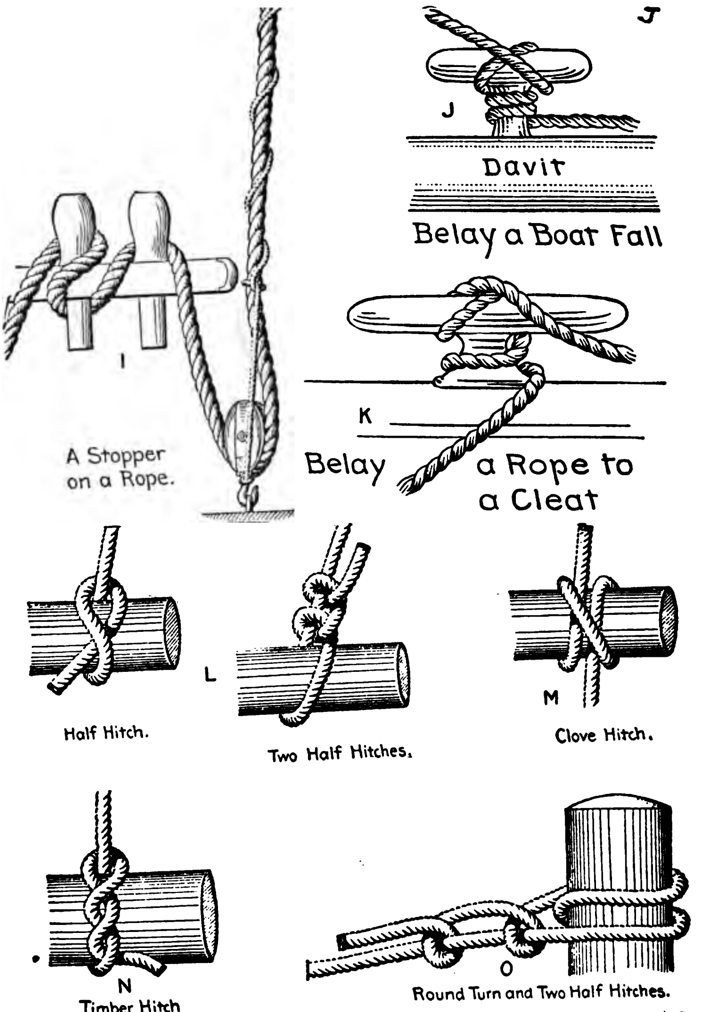
This cannot be learned merely by glancing at the picture nor by watching others; it must come through practice.

Splicing is joining ropes together by uniting their strands. Seizing is binding two parts of a rope together with spun yarn or marline.

The following are recommended for study by the reader. He will find each clearly illustrated in books on seamanship and can readily learn to do them himself:



From Rear Admiral A. M. Knight's "Modern Seamanship," D. Van Nostrand Co.



From Rear Admiral A. M. Knight's "Modern Seamanship," D. Van Nostrand Co.

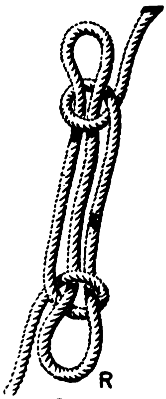
Single Blackwall Hitch.

P

Double Blackwall Hitch.

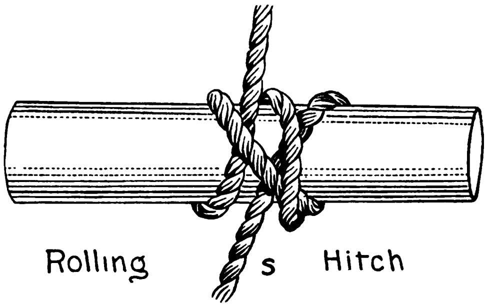
Cat's paw.

Q

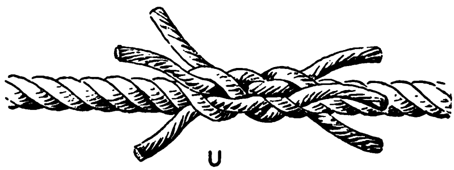


R

Sheepshank.



Rolling S Hitch

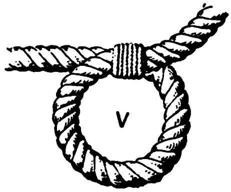


U

Short Splice

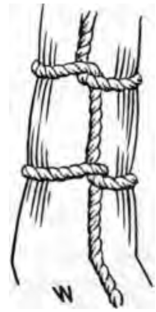
T

Eye Splice.



V

Throat Seizing.



W

Marling Hitch

From Rear Admiral A. M. Knight's "Modern Seamanship," D. Van Nostrand

(a) Knot a rope yarn.
(b) Overhand knot.
(c) Figure-of-eight knot.
(d) Square knot.
(e) Bowline knot.
(f) Running bowline.
(g) Bowline on a bight.
(h) Clap a jigger on a rope.
(i) Stopper a rope.
(j) Belay a boat fall.
(k) Belay a rope to a cleat.
(l) Half hitch.
(m) Clove hitch.
(n) Timber hitch.
(o) Round turn and a half hitch.
(p) Blackwall hitch.
(q) Cats paw.
(r) Sheep shank.
(s) Rolling hitch.
(t) Eye splice.
(u) Short splice.
(v) Seizing.
(w) Marling hitch.

Tackles are for the purpose of multiplying power and are composed of ropes and blocks. Work with tackles is part of the everyday life of a sailor.

The following tackles are much in use on board ship: (1) single whip, (2) a runner, (3) gun tackle purchase, (4) luff tackle, (5) twofold tackle, (6) Spanish Burton, (7) double Spanish Burton, (8) threefold tackle. These are illustrated with line sketches (Fig. 5). P = pull, W = weight.

The powers given are theoretical, considering friction as zero. However, each sheave over which the rope runs adds $^1/_{10}$ in friction. For instance, the twofold purchase (5) is theoretically P = ¼ W. When friction is considered it becomes P = 14/40 W., adding the friction of four sheaves.

BOATS

Vessels of the United States Navy are supplied with one or more of the following classes of boats:

(From the Deck and Boat Book, U. S. Navy.)

Steamers,	Motor whaleboats,
Motor boats,	Dinghies,
Sailing launches,	Dories,
Motor sailing launches,	Motor dories,
Cutters,	Wherries,
Whaleboats,	Punts, catamarans, etc.

Steam barges or motor barges are furnished flagships.

A *whaleboat used* by a commanding officer and flying *his pennant is known* as a gig while so employed.

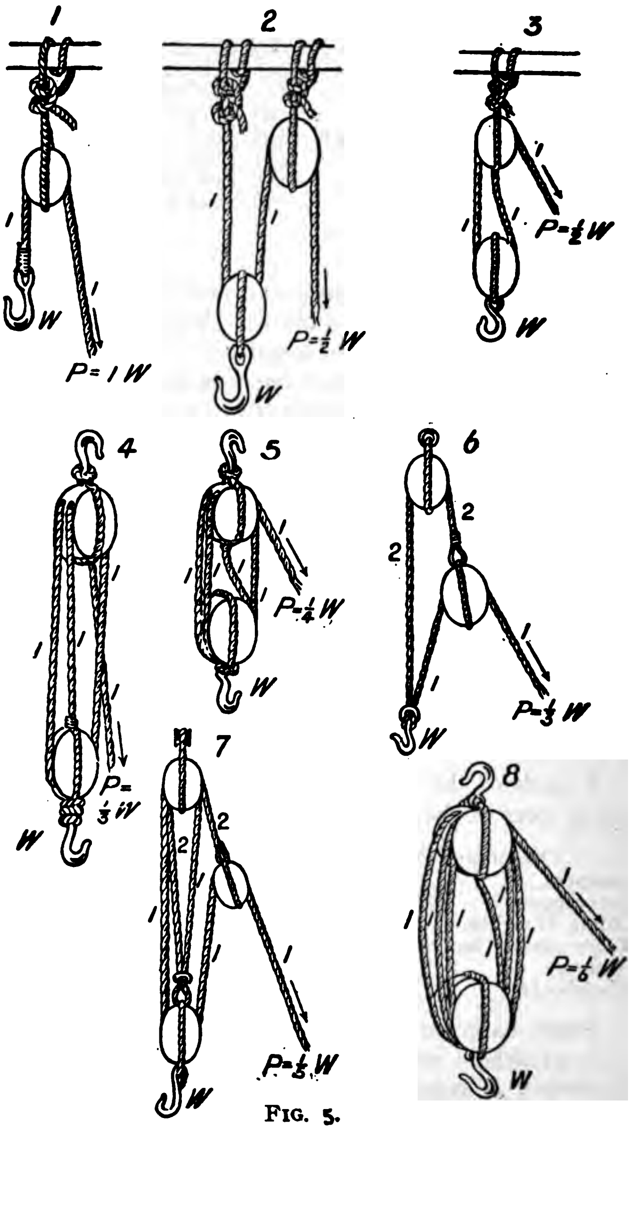


FIG. 5.

General Remarks.—The size of ship's boats is indicated by their length in feet; for example, a 28-foot cutter, a 36-foot steamer, etc. The following is the length (in feet) of the boats now supplied to vessels: steamers, 50, 40 and 30 feet; motor boats of various sizes; motor sailing launches and sailing launches, 50, 40, 36, 33, 30 and 24 feet; cutters, 30, 28, 26 and 24 feet, and a standard 31-foot racing cutter; whaleboats, 30, 28, 24 and 20 feet, dinghies, 20 and 16 feet; motor dories, 21 feet; dories, 17 feet; wherries, 14 and 12 feet; and punts, 14, 12 and 10 feet. Boats of the various classes are distinguished in each ship by their numbers in each class—first, second and third steamers; first and second whaleboats, etc.

Steamers.—All steamers of the regulation type are fitted to mount a light rapid-fire or machine gun in the bow. They are not fitted with sail power, but are fitted with rowlock sockets in the gunwale and should always carry two oars and rowlocks for use in an emergency. Those assigned to the use of flag officers are termed steam barges.

Sailing launches are heavy working boats, square sterned, and generally sloop rigged. They are fitted to mount a light rapid-fire or machine gun in the bow. They are supplied with oars, and instead of rowlocks they have grommets and thole pins; by double banking the oars a considerable speed may be attained. These boats are specially designed for ship's heavy work, such as carrying stores or large liberty parties or a landing force, carrying out anchors, weighing kedge anchors. All sailing launches are now built with engine foundation, shaft log, etc., so that a motor may readily be installed. When motors are installed in sailing launches the boats are termed motor sailing launches. Motor sailing launches are considered primarily as pulling (or sailing) boats, and they have all of the outfit of sailing launches, and, in addition, the running lights, bell, foghorn, etc., required by law. The *24-foot sailing* launch is fitted with swivel rowlocks and *lug rig.*

Cutters are double-banked, square-sterned boats, with finer lines than launches, pulling 10 or 12 oars, according to size. They are used as running boats and for ship's general duties and are fitted with either sunken or swivel rowlocks. Their sailing rig is the sliding gunter or double standing lug rig, either with or without jib. They are frequently fitted to carry a light rapid-fire or machine gun in the bow. These boats are *not* being supplied to the newest vessels.

Whaleboats are double-ended and may be either single or double banked, pulling 6 or 12 oars, respectively. They are used as running boats and for ship's general duties of a lighter character than that assigned to launches and cutters. They are fitted with swivel rowlocks. Their sailing rig is the sliding gunner or double standing lug rig, frequently without a jib. In port they are steered with a rudder, but at sea are fitted with a steering oar passed through a steering rowlock on the quarter. These boats are therefore particularly adapted for use at sea and are generally used as lifeboats.

Dinghies are small handy boats, shaped like cutters, single banked with four oars. They are used as market boats or for light rough work or ship's light duties. Owing to the small crew required, they are particularly convenient for nearly any light work in port. They carry sails and are sprit rigged.

Wherries are light, handy boats for officers' use, can be pulled by one man and are not furnished sails.

Punts are rectangular flat-bottomed boats intended for painting and general cleaning around the ship's water line. They are fitted with rowlocks on each side, but are usually propelled by sculling.

Catamarans (or Balsas) are platforms secured to two hollow floats. They are used for the same purpose as punts, but are less handy. They are really carried on account of their demonstrated value in case of ship-*wreck. They* are fitted with swivel rowlocks and oars, *but are usually* sculled. Life rafts of various designs

are sometimes carried, but no regulation type has been adopted.

Motor boats are classified as follows:

(1) The barge of a flag officer as a "motor barge."

(2) Service type launches built for heavy duty, and speed and semispeed boats as "motor boats."

(3) Sailing launches with auxiliary engines as "motor-sailing launches."

(4) Double-ended power boats, whaleboat types, as "motor whaleboats."

(5) Power dories as "motor dories."

Nomenclature.—The following are the authorized names of the various parts of a naval boat:

Backboard.—The thwartship board immediately forward of the coxswain's box, placed across the stern sheets of the boat to support the backs of the occupants.

Bilge.—The flat part of a boat's bottom, on each side of the keel, on which the boat would rest if aground. The bilge extends out to where the frames turn upward, which part is known as the "turn of the bilge."

Blade.—The broad flattened part of an oar.

Boom.—The long pole or spar used to extend the foot of a fore-and-aft sail; for example, main boom, jib boom.

Bottom Boards.—The fore-and-aft strips secured to the frames, forming the floor of the boat.

Brails.—The lines used for hauling the clew of a sliding gunter sail up to the masthead. They are secured to the clew of the sail, lead up through leaders at the masthead, thence down into the boat.

Clew (of a sail).—The lower after-corner of a fore-and-aft sail.

Deadwood.—A body of timber built on top of the keel at either end of the boat to afford a firm fastening for the cant frames.

Frames.—The ribs of the boat; curved timbers secured to the keel and extending upward to the gunwale.

Fore Sheets.—The portion of the boat forward of the foremost thwart.

Gaff.—A spar used to extend the upper edge of the quadrilateral fore-and-aft sail of a sloop rig.

Gooseneck.—A sort of iron hook fitted to the inner end of main boom, used for securing the latter to the main-mast. It permits free movement of the boom in any direction, with the gooseneck as a centre.

Gripes.—Boat gripes are made of sennit or canvas and go around the bottom of the boat in securing a boat for sea, those for lifeboats being usually fitted with a slip hook. Boat gripes for steamers and sailing launches are made of chain, have a hook or clamp on the rail and are secured to the deck by turnbuckles.

Gudgeons.—Small metal fittings, similar to eyebolts, se-cured to the stern post of a boat for the rudder to hang on. They receive the pintles and thus support the rudder.

Halliards.—Lines used to hoist and lower topmasts or yards or jibs, or the gaff of a sloop.

Handle (of an oar).—The small part of an oar, on the inboard end of the loom, which the oarsman grasps when pulling.

Head of Sail.—The upper corner of a triangular sail. The upper edge of a quadrilateral sail.

Heel of Mast.—The lower parts of the boat's mast; the end of the mast which fits in the step on the keel.

Keel.—The principal timber of a boat, extending from stem to stern at the bottom, and supporting the whole frame.

Leather.—The portion of the oar which rests in the row-lock. This is sometimes covered with canvas, but is usually covered with leather, hence the name.

Loom.—The portion of an oar extending from blade to handle.

Lug Rig.—Applied to large quadrilateral sails bent to yards that hang obliquely to the mast; the halliards *being secured* nearer to one end of the yard than to the *other. In the* "standing lug" rig used in the navy, the

fore tack is lashed or hooked to an eyebolt on the afterside of the foremast.

Main Boom.—The boom on the mainmast which spreads the foot of the mainsail.

Oars.—Long wooden implements for propelling boats by pulling. Oars consist of blade, loom and handle.

Painter.—A rope, secured in the bow, for towing or securing the boat.

Peak.—The upper after-corner of a quadrilateral fore-and-aft sail.

Pintles.—Small straight pieces of metal secured to the rudder and fitting in the gudgeons on the sternpost, thus supporting the rudder. In some boats the pintle is a long erect pin on the sternpost fitting in rings or gudgeons on the rudder.

Plug.—The stopper which is placed in the drain hole when the boat is lowered. It should be secured in the boat by a small lanyard or chain.

Rising.—The narrow fore-and-aft strakes inside of a boat, secured to the frames, on which the thwarts rest.

Rowlocks.—Forked pieces of metal in which the leathers of oars rest while pulling. Sunken or box rowlocks are those which are set down in the gunwale of the boat. Swivel rowlocks are movable, the shank of the rowlock fitting in a socket in the gunwale.

Rudder.—A flat board hung abaft the sternpost by means of gudgeons and pintles used for steering a boat.

Sheer.—The rise of the longitudinal lines of a boat from the horizontal plane, as seen in looking along a boat's side. The curve of the gunwale when compared with the straight water line.

Shrouds.—Lines stretched from the masthead to the boat's rail. They support the mast on each side.

Sliding Gunter Rig.—A rig for boats in which a sliding topmast is used to extend a triangular sail. As used in the navy, it consists of two triangular sails (fore and mainsail) and usually a jib. The mainsail is fitted with a main boom.

Sloop Rig.—Consists of a large fore-and-aft quadrilateral sail with gaff and boom, also a jib and jib boom.

Sprit Rig.—Consists of a single mast carrying a large quadrilateral sail, the peak of which is held out by a light movable wooden boom, called a sprit, which, when in place, extends from the peak of the sail to a stirrup on the lower part of the mast.

Stem.—The upturned portion of the keel, at the bow of the boat, to which the forward ends of the planks are secured.

Step of Mast.—A small metal receptacle on the keel in which the heel of the mast rests.

Steering Rowlock—A peculiar form of swivel rowlock, fitted near the stern of a whaleboat, in which the steering car is shipped This is sometimes called a crutch.

Stern Fast.—A stern painter for use in securing the stern of a boat.

Sternpost.—The principal piece of timber in a boat's stern frame. It is a vertical continuation of the keel at the afterpart of the boat.

Stern Sheets.—The space in the boat abaft the thwarts.

Strakes.—Continuous lines of fore-and-aft planking. Each line of planking is known as a strake.

Stretchers.—Athwartship, movable pieces against which the oarsmen brace their feet in pulling.

Strongback.—The spar lashed to the two davits on which a boat is hoisted.

Tack.—The forward, lower corner of a fore-and-aft sail.

Thrum Mats.—Mats made of a small piece of canvas with short strands of rope yarn sewed on it called "thrumming." These are placed between the rowlocks and the oars to prevent noise in pulling.

Thwarts.—The seats on which the oarsmen sit.

Throat.—The forward upper corner of a quadrilateral fore-and-aft sail in a sloop rig. Also called the neck.

Tiller.—A bar or lever, fitted fore-and-aft in the rudder head, by which the rudder is moved.

Topping Lift.—A line used for supporting or hauling up the boom of a fore-and-aft sail.

Trailing Lines.—Small lines secured to the boat and around the oars to prevent the latter from getting adrift when trailed.

Yard.—A spar to which the head of a lug sail is attached. The term lug is applied to the forward part of it when it has to be dipped (in some rigs) from one side to the other of the mast in going about.

Yoke.—Athwartship piece fitting over the rudder head, and by which the rudder is moved when the tiller is not shipped.

Yoke Lanyards.—Small lines attached to or rove through the ends of the yoke for use in steering when the yoke is shipped.

LIFEBOATS.

(From the Deck and Boat Book, U. S. Navy.)

At Sea.—When at sea every ship at all times keeps on each side, ready for lowering, a boat which is best adapted for a lifeboat.

At the beginning of every watch at sea the officer of the deck has the lifeboat crew of the watch mustered abreast the lee boat and the coxswain of the lifeboat crew of that watch will satisfy himself by personal inspection that *both* lifeboats are ready for lowering and will report the fact to the officer of the deck.

A lifeboat is secured for sea, *i.e.*, ready for lowering, when in the following condition: Boat at the davits, griped in, falls clear, detaching apparatus ready for detaching at the word, steering oar shipped in crutch, oars fitted with trailing lines and ready for getting out quickly, rowlocks shipped and fitted with lanyards, plug in, sea painter half-hitched around forward thwart, life lines bent to span, life jackets in boat, lantern filled and trimmed (and at night lighted), and all other articles *of the boat equipment* in the boat and ready for use, with *two days' water* and provisions for the crew. When the

coxswain of the lifeboat crew of the watch reports a lifeboat ready for lowering, it is understood that the boat is in the above condition and that the crew of the watch have been mustered each man abreast his own thwart (or station) of the lee boat and that each man understands his duties at "man overboard." In lowering, the officer or coxswain in charge of the lifeboat will give the command for detaching. (The British Navy make this latter the duty of the officer of the deck.)

In Port.—The United States Naval Instructions require that "in port one or both lifeboats shall be kept ready for immediate use from sunset until colors the next morning." Hence when there is no suitable boat in the water ready for immediate use as a lifeboat, at least one boat suitable for this purpose must be kept ready for instant lowering. This is particularly necessary when the boats which are in the water are heavy and unwieldy or are so secured that they could not be quickly used in an emergency or in rough weather or in a strong tideway.

Owing to its handiness a dinghy is well suited for use as a lifeboat in port in good weather, and under such conditions it may be designated as the lifeboat for port service. The boats designated for use as lifeboats in port are required to carry only the usual equipment for boats in port, but the gear must be in order and ready for instant use, and the lantern must be ready in the boat for lighting, or else a lighted lantern ready for use must be kept at hand on deck.

Notes on Lifeboats (Deck and Boat Book):

(1) Lifeboats should be griped securely against their strongbacks, with chafing pads between the boat and the strongbacks, and the gripes, secured by toggle or pelican hook, ready for instant freeing.

(2) If gripes stretch and become slack they should be set up taut.

(3) At night boat falls should be coiled down on deck, clear for running; during the day the coils may be triced up to the davit with becket and toggle.

(4) The sea painter is led from a point well forward on the ship, outside of everything, and secured to the inboard side of the forward thwart in such a manner that it can be readily cast off; if necessary, it is stopped up out of the water by a rope yarn.

(5) The knotted lifelines, one for each member of the crew, hang from the span for the use of the crew in case of accident in lowering or hoisting.

(6) The life jackets should be placed, one under each thwart and one under the stern sheets, and each man in the lifeboat shall put one on before the boat is lowered. This is necessary because of the danger of the boat swamping alongside in rough weather.

(7) If the lantern is not provided with a shutter, it shall be fitted with a canvas screen, and when lighted and not in use shall be put in the boat bucket.

(8) Lifeboat crews for each watch are designated on the ship's station bill. When a lifeboat crew is mustered, the men shall muster in line abreast their boat (or the lee-boat) in order of their thwarts, facing inboard; men stationed to lower will be abreast their respective davits, and shall personally see that the falls are clear.

(9) The proper members of the crew shall be permanently stationed for unhooking the falls, tending the sea painter, and for performing other duties in connection with lowering. The lifeboat crew of the watch, including the men stationed for lowering, for observing the man, for signalling, etc., are not to leave the weather deck without permission, except for meals.

(10) At night the lifeboat crew of the watch, and other men stationed in connection therewith, shall remain near their stations.

Lowering a Lifeboat at Sea in Bad Weather (with wind and sea forward of the beam—Deck and Boat Book):

(1) At the call "Man overboard" (which may be given by word of mouth or sounded on the bugle) every member of the lifeboat crew of the watch goes to his

station on the *run*. The lee lifeboat should be manned. If there is any doubt about which boat is to be lowered, the officer of the deck immediately indicates it by the command "Clear away the starboard (or port) lifeboat."

(2) The men take their seats on the thwarts; each man immediately puts on a life jacket, gets his oar ready, and then, if not otherwise engaged, seizes a lifeline as a safety precaution in case of accident.

(3) If there is not a good lee, the officer of the deck shall make one by altering the course of the ship. It is customary to bring the sea a little on the bow, but in this position the lee for the boat is far from perfect, as the ship will roll and pitch considerably, and the waves wash along the lee side. Some seamen prefer to bring the sea on the quarter rather than on the bow, while others advise lying in the trough of the sea, notwithstanding the heavy rolling. The best position will doubtless depend upon the build and trim of the ship and the nature of the sea. (If in formation, the ship shall be handled as directed in Fleet Tactics.)

(4) Oil should be used in any case, both ahead and astern of the boat.

(5) The ship should be kept moving slowly ahead. A sea painter, from well forward, should be brought into the boat through the inboard row bowlock, and a turn taken around the inboard end of the forward thwart.

(6) To keep the boat from swinging, frapping lines may be passed around the falls, the ends leading inboard, to hold the boat close in to the side as it is lowered. In some ships, jackstays with travelling lizards, are fitted from the davit heads to the side of the ship. A turn of the lizard is taken under a thwart, or around the standing part of the fall, and the boat is held near the side, as by the frapping lines above described. Under no circumstances should the lizard be secured to the boat so that it *could jam*; the end must be held in the hand.

(7) The great danger, both in lowering and immedi-*ately afterwards*, is that the boat will be dashed against

the ship's sides. A sea painter brought in on the inner bow of the boat, as already described, helps to sheer her off as she strikes the water. The coxswain sheers the bow out by throwing the *stern in* with the steering oar as the boat strikes the water.

(8) The after fall is always unhooked first.

(9) Under no circumstances, short of the most imperative necessity, should a boat be lowered while the ship has sternway; and it is always *desirable* to have a little headway. There is much difference of opinion as to the speed at which it is safe to lower a boat—an important question in picking up a man overboard. Some officers have seen boats lowered without accidents at speeds as high as 8 and 10 knots, maintain that it is perfectly safe to lower at this speed. A more conservative view fixes the maximum at something like half this speed. It is safe to say that there is far less danger at 5 knots than 10, and most practical men would prefer to wait a little longer rather than to take the chance of having to deal with a whole boat crew in the water.

(10) When all is ready the officer of the deck, or the officer in charge of the lowering, commands " Lower away together." The bow and the stroke oars tend the falls to keep them clear and to keep the blocks from striking other members of the crew when let go. In case the tumbler hook is used, these men grasp the tumbler lanyard, and as soon as the boat is water borne, unhook the fall, in case it is not unhooked automatically. Should the boat not be supplied with detaching apparatus, these men unhook the boat falls—*the after fall* first—as soon as possible after the boat touches the water. Men in the waist thwarts hold the boat off, if the ship is rolling. The second bowman tends the sea painter, which is hauled taut and brought in through the inboard bow rowlock before lowering. He takes a turn with the painter around the thwart, holding the end in his hand; *it should never be made fast.*

(11) In lowering a boat the falls must invariably be lowered together, and in rough weather smart lowering may be required.

(12) If the boat is held in by lizards travelling on jackstays, or by frapping lines around the falls, some of the men in the waist should breast the boat off the ship's side with the boat hooks, being careful to hold the butt end above the outer gunwale to avoid danger of the boat being driven against it and its staving a hole in the planking.

(13) It is well to have an axe or hatchet handy in case anything should jam at a critical time.

(14) When the boat is a short distance from the water the officer of the boat, or in his absence the coxswain, lets go the detaching apparatus, or gives the command "Let go." If the boat is not fitted with detaching apparatus, as soon as the boat is water borne, the boat officer or coxswain commands "Let go the after fall," then, "Let go the forward fall." The coxswain gives the boat a sheer out. The greatest danger occurs at this instant, as there is always a danger of the boat being dashed against the ship's side. For that reason the coxswain should give the *stern a sheer in,* to get the *bow out.* The strain on the sea painter assists to get the bow out. When clear of the ship's side, the officer or coxswain directs the second bowman to cast off the sea painter; thwartmen get out their oars as soon as possible, and the boat makes the best of her way to the rescue.

Hoisting a Lifeboat (or Other Boat) in a Seaway. (Deck and Boat Book):

(1) The same general principles of seamanship apply as in lowering. It is preferable for a ship to have a little headway on in case she is under way. The important point is to keep the boat off the ship's side to prevent it being injured.

(2) The boat comes alongside, a lee having been *made for her,* and in case of a heavy sea oil should be used *freely.* Oars are boated before getting alongside, as soon

as possible after receiving the sea painter, which should always be hove to her.

(3) The bowman seizes the sea painter and takes a turn around the forward thwart. The boat should then be hauled under the davits by manning the sea painter on deck.

(4) Tend the ship carefully to retain a lee.

(5) Frapping lines, travelling lizards, etc., will, if necessary, be used as in lowering. Similarly, thwartmen will, by the use of boat hooks, keep the boat from swinging against the ship's side.

(6) If the ship has considerable way on a line should be led from the stern of the boat to a point well aft on the ship, to prevent the boat from lurching forward when she leaves the water.

(7) The boat falls should be well overhauled, led along the deck so that the men have a clear hauling space, and they *must be well manned.* The boat should never have to wait for preparations on deck.

(8) All being ready on deck, stand by, wait for a smooth time, hook forward, then aft, haul taut, hoist away. Men should run away with the falls as the ship rolls toward the boat, which should be run up quickly but steadily. If the winch is used, the falls should be taken around the barrel, which should be turning at the desired speed before the order "Haul taut" is given.

(9) Boats fitted with automatic releasing hooks should have their falls rove off in one, single leaders at the davit heads, and the blocks must be of sufficient size to permit the falls to render easily.

A Method of Picking up a Man Overboard (particularly with the wind and sea abaft the beam). (Deck and Boat Book):

(1) The following method of picking up a man in good, moderate or rough weather with a quick-turning steamer, commends itself to many seamen:

(2) At the call "Man overboard" ascertain the position of the man, put the rudder hard over toward

him, so as to make a short turn without stopping. If possible, stop the engine on the side on which the man falls, so that he will not be struck by the propeller.

(3) As the ship turns, clear away and man the life-boat which is to be lowered, at the same time keeping a good watch on the man; his approximate position will be marked by the lifebuoy. As the ship approaches the man, toward the end of the turn, manœuvre her so as to bring her just to windward of him, and slow the engines so that she will not have too much speed for lowering when she reaches this position. Lower and let go with such precautions as wind and sea demand; stop the ship or get her in position to leeward of the man.

(4) The advantages of this method are:

(*a*) That the boat may be dropped near the man, so that the coxswain can steer straight for him without being signalled to.

(*b*) That there is plenty of time to get the boat ready for lowering, and consequently less risk due to haste.

(*c*) That the boat has a short leeward pull to the man, and while the interval before the boat is in the water may be longer, the interval before it reaches the man would generally be shorter.

(*d*) That the officer of the deck has better control for regulating the speed at which he is to lower the boat.

(*e*) That the interval between the alarm and lowering the boat being greater, there is less chance of accident from excitement and confusion.

(*f*) That by turning after the boat has been lowered the boat will have a pull to leeward after picking up the man.

Life-Buoys. (Deck and Boat Book):

In connection with "Man overboard," attention is invited to the regulations concerning life-buoys.

The Naval Instructions require that at all times at sea, and where anchored in a strong tideway in port, an *efficient person* be stationed to let go the life-buoy. Except *in small ships*, one man is usually detailed for each

life-buoy. These men also act as lookouts, and it is important that they clearly understand their duties.

Men on this post must realize that should a man fall overboard his life will depend largely upon the intelligence and alacrity with which they perform their duty. They must, therefore, know (*a*) how to let go the life-buoy, and (*b*) when to let it go.

Ordinarily life-buoys are let go by pulling a toggle, which releases the buoy, allowing it to fall in the water. Should it not fall of its own accord it is probable that a slight blow will cause it to do so. The men on that post should, however, understand how to cause it to drop in case the toggle carries away, the mechanism jams or the buoy fails to fall through any cause. They must, above all, understand *that the buoy must be dropped immediately in some way,* and that it is insufficient for them to simply make a routine effort to drop it, and then report that they cannot do so. To familiarize the men on this post with the operation of the life-buoy it is well to have them present occasionally when the gunner tests the life-buoys in making preparations for sea.

The question as to *when* to let the life-buoy go requires intelligence and composure. A cool, intelligent lookout will let the buoy drop within a few feet of the man overboard, while if somewhat excited, or if he does not clearly understand his duties, he may drop it long before the man is abreast the buoy, or long after he has passed.

At the call " Man overboard " the life-buoy lookout should endeavor instantly to ascertain the side on which the man fell and to *get sight of him;* then drop the buoy as soon as possible *after* the man is abreast the buoy, so that it will be between him and the ship, toward which he naturally faces and swims.

If the man cannot be seen, the lookout can usually determine the side on which he fell, as he will see many *of thc people* about decks go to that side. Then, to avoid *the possibility* of dropping the life-buoy on the man (in-

stances are recorded where men have thus been killed) the opposite buoy should be dropped when judged to be abreast of the man in the water.

If the man is seen after the first buoy is dropped, and it is then seen that the second buoy can be dropped nearer him, it should be let go; but as a general rule the second buoy should be kept fast (unless it is really needed) for use in case men fall overboard in lowering or hoisting the lifeboat.

The above instructions are for the guidance of the life-buoy lookout in case he hears no orders and must, therefore, act upon his own initiative. He shall, of course, strictly and promptly obey any commands that he may receive from proper authority, regardless of the above instructions; but as the life-buoy, to be of use, must be dropped promptly, the lookout must clearly understand that if no orders have been received by the time it is necessary to drop it (as indicated above), he must drop it at once.

Modern vessels are so large, and life-buoys so far removed from the officer of the deck, that it is important that the life-buoy lookout clearly understand the above general principles, and then in the absence of orders, that they be governed by their common sense.

After dropping the buoy the lookout should keep the man in sight until the persons specially detailed for this purpose reach their station in the after-rigging, and get the bearing from the life-buoy men. If one lookout is attending both buoys it would be unwise for him to leave his station to go into the after-rigging as a lookout, but if there are two life-buoy lookouts, each may be permanently stationed to go in the rigging and keep a lookout on the man after his own buoy has been let go.

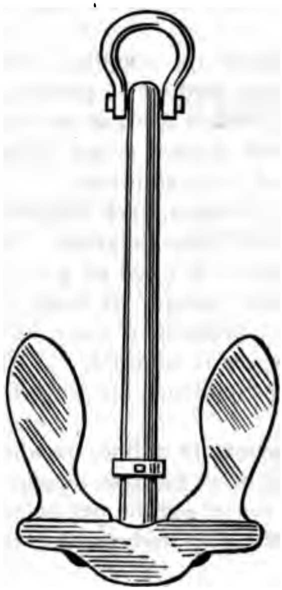
Life-buoys should be dropped frequently when the crew are in swimming, in order to familiarize the men with their use.

Ground Tackle.—Patent anchors, stockless, have been definitely adopted for use in the United States Navy.

Anchor chains are made of studded links—an open link is placed on either side of a shackle.

The size of the chain is designated by the diameter of the iron of which the chain is made.

The length of a shot of chain in our navy is 15 fathoms, or 90 feet. The first "shot" of the chain from the anchor is of about 5 fathoms and the second 40



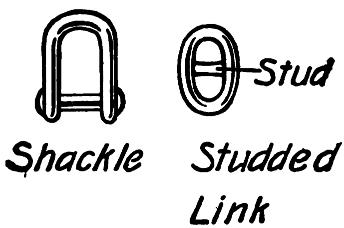


FIG. 6.

fathoms in length. The object of this is to avoid having a shackle on the windlass while breaking the anchor out of the ground.

Shots are joined together by shackles, bowed end of shackle must be placed forward. The shackles used in the navy are arranged for quick unshackling.

Swivels in chain cables are to prevent the accumulation of turns.

Cables are stowed in chain lockers.

Both steam and electric windlasses are used.

By means of the compressor the chain is held by friction from running out.

The controller catches the chain as it is heaved in link by link and holds it in case of slipping.

Modern anchors house in the hawsepipe. To let go, disconnect windlass engine shaft, raise controller, come up compressor, release friction band on windlass. Anchor will fall by gravity.

In addition to the friction band on windlass, the controller and compressor, a further method of securing the chain is provided by stoppers, which are put on the chain after the ship is anchored with desired scope. The friction band on windlass is hauled to in addition.

In discussing the letting go of anchors, each individual class of ship must be taken into consideration. In some ships anchors can be let go with a speed of 4 to 5 knots on the vessel and the vessel brought to dead in the water by the engines before 45 fathoms of chain has run out. In others much slower speed is advisable. The depth of the water will have a large influence upon a safe speed in letting go anchors.

Mooring is to lay out two anchors in a line, usually at 90 fathoms apart, the ship riding to 45 fathoms on each cable. If desirable, the mooring swivel can be put on to prevent cables from fouling as the ship swings, due to effect of current and wind.

To clear hawse, the clear hawse gear is used, consisting of clear hawse pennant, dip rope, easing away line, preventer hawser. The ship rides to the riding chain; that is, the one with a strain upon it. The other chain is heaved in until the 45 fathom shackle is on deck. This chain is then held fast by means of the clear hawse pennant and preventer hawser. (Preventer hawser usually not belayed.) Chain unshackled, both ends held fast, dip rope is taken around the riding chain in opposite directions to fouling chain and brought in again and bent to end of chain to be dipped. Easing away line is used to pre-

vent chain from running out too fast. Now hauling away on dip rope, the turn can be taken out and chain reshackled.

Advantages of a long scope of chain are that pull is at a more acute angle, being nearly parallel to the bottom, and, what is more important, the ship in first lifting the weight of the chain is thus retarded and the final pull on the anchor is less. In other words the pull is maintained more steadily and not violently.

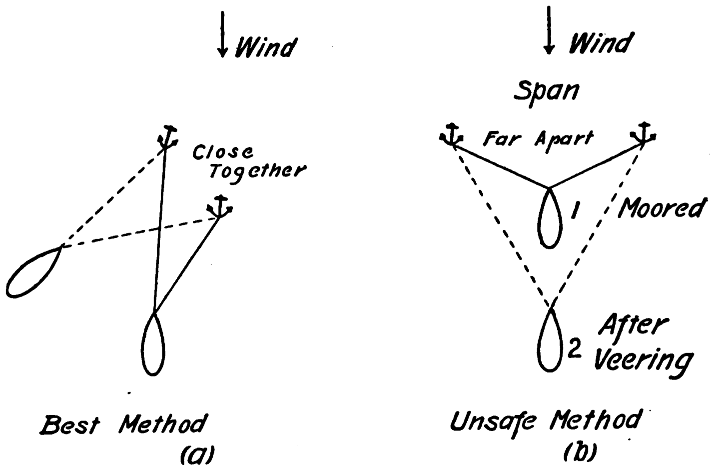


FIG. 7.

In anchoring during heavy weather or for heavy weather, it is vastly better to have both anchors in the direction of the strong winds expected or then blowing.

Lying to a span of chain brings tremendous strains on the chain. See Fig. 7.

A vessel at single anchor preparing to remain at anchor during a gale will usually heave in to 15 fathoms on riding chain, then let go the second anchor and veer to 90 fathoms on the first chain and an amount on second *chain to divide strain* equally between the two. See above *sketch (a).*

The Turning of Single Screw Vessels.—A single screw vessel in turning is affected by the position of its rudder, the direction in which the screw current is moving, the direction in which the screw blades are revolving and the direction of the vessel through the water.

A right-handed screw vessel turns more readily with right rudder. Left-handed screw steamers are seldom if ever encountered. Consider a vessel at rest; put rudder right and go ahead on screw; the screw current against the rudder will tend to throw stern to left; the sidewise push of the blades will tend to throw stern to right. When the ship gains headway the wake current

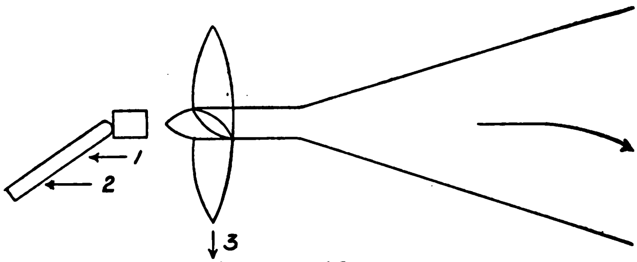


FIG. 8.

against the rudder will add its effect and further tend to throw stern of vessel to the left. The result will be, the ship will turn to the right.

After gaining headway reverse the engine, shift rudder to left. The screw current against the rudder will tend to throw stern to left, the sidewise push of blades will tend to throw stern to left, the "going ahead" wake current against the rudder will tend to throw stern to right but its effect is slight compared to the stronger *screw current.* The result will be to swing the stern to *the left, and ship* will continue to turn to right. When

ship gains stern board the wake current will add its effect in swinging stern to the left.

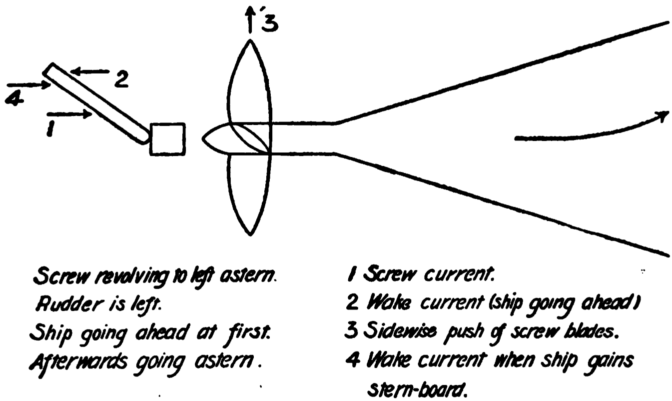


FIG. 9.

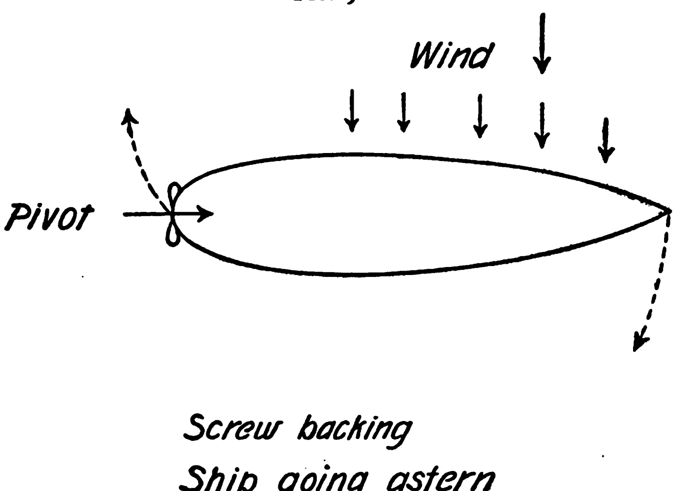


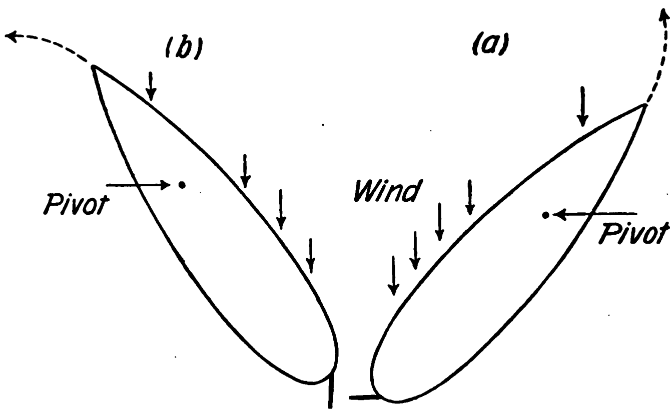
FIG. 10.

If turning, with a strong wind blowing, a vessel *usually tends to* back into the wind. The reason for this *is that the* stern is held as a pivot by the revolving screw

and the wind pressure against the side of the vessel blows the bow away from the wind.

If turning in a strong current, a vessel usually will back into the current. The cause is the same, substituting current for wind.

If a vessel is going ahead and turning its bow toward the wind it will be found that it is easy to point the wind, but after pointing it the bow will fall off less rapidly in the desired direction.



(a) Ship turning with left rudder, to left, wind on port bow.
(b) Ship turning with left rudder, to left, wind on starbord bow.

FIG. 11.

The reason is that a vessel going ahead and turning pivots somewhere forward of its midship section. The wind pressure until pointing the wind acts to help the turning; that is, it blows the stern pivoted somewhere forward. After pointing the wind the wind pressure acts against the turning. The same is equally true if turning into the tide.

Turning of Twin Screw Vessels.—This is very much more simple than turning a single screw vessel. A twin

:rew vessel turns equally well to right or left Con-iderable turning moment can be given with the screws.

To turn a twin screw vessel from rest go ahead oth engines, putting rudder in direction it is desired to ast or turn. After bow has begun to swing rapidly, ack the screw on the side toward which the bow is swing-

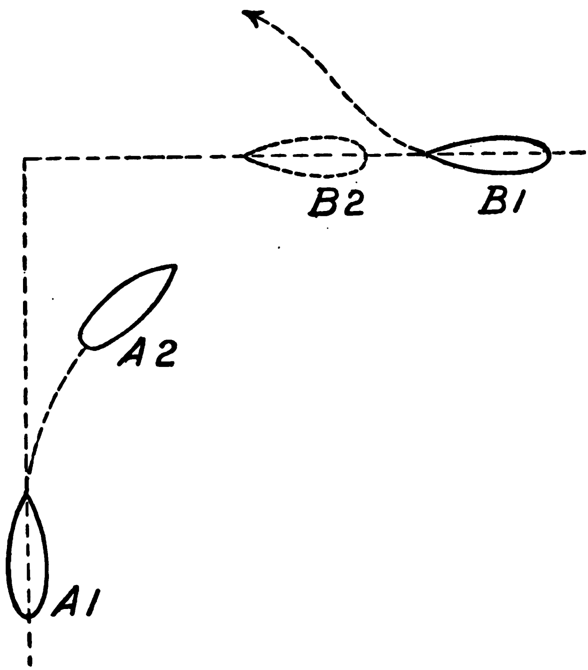


FIG. 12.

ng, keep rudder toward side vessel is turning, or else ›ut amidships—depends somewhat upon vessel. Ship hould be given slight headway by regulating speeds of crews.

Manœuvring in a Fog.—A safe rule in a fog is, if a *essel's fog whistle* is heard forward of the starboard *:am indicating it is* crossing your bow, stop the engines

at once and bring fog whistle ahead or nearly so by using right rudder. If the whistle is heard forward of your port beam stop engines, but do not turn toward the other vessel.

The reasons are that the vessel on your starboard bow, by the rules of the road, has the right of way and you are required to go astern of her; the vessel on your port bow is required to go astern of you.

If with the vessel on your port side you elect to turn away from the danger, that is with right rudder, then do not slow, but on the contrary, increase speed so as to cross her bow as soon as possible. Turning away from a danger should carry with it the precaution of increasing speed.

A hears *B's* whistle on starboard bow. *A* stops engines, uses right rudder and at *A2* is practically stationary, pointing its bow to the danger. *B* has the right of way.

B hears *A's* whistle on port bow. *B* stops and holds course. If location of *A* can be definitely fixed, then *B* may turn away with right rudder, maintaining speed or increasing it. *B* has the right of way.

The reasons for these actions are that by turning toward the danger fewer lines of probable courses are cut.

If vessels are so close as to make collision inevitable, bow presentation is safer and a glancing blow might be negotiated in case vessels are coming together nearly bows on. Of course by this time speed through the water should be materially reduced.

Docking and Anchoring.—Handling a vessel with lines alongside of a dock is merely a question of forces and pivoting points. If a sketch is made showing where lines are made fast the action of the vessel when a strain is put on the lines can readily be foretold.

In handling turbine ships it must be remembered that due to the small size of their propellers they have not the same backing power as ships with reciprocating engines. *For this reason* when anchoring or going alongside of a *dock speed must* be taken off earlier.

In anchoring a modern battleship, never let go the anchor with more than about 2 knots headway and never permit the chain to be held until headway has been deadened by the engines. The bringing of sudden strains on the chain cables with our monster ships will seriously endanger the chain cable and will be the cause of parting the chain.

SIGNALLING

Signalling is the method of communication between vessels of the navy. It comprises several systems.

Our systems includes the flag code, semaphore code and the dot-and-dash code. The dot-and-dash code is to all intents and purposes simply the International Morse Code with certain additions.

There are several methods of signalling used by our warships; each is used frequently in order to give the signalmen practice. In times of emergency the most effective at the instant would be employed.

In the approach to battle, radio (wireless) signals would be employed; this would be supplemented with flag signals in daytime and occulating light signals at night.

Wigwag and semaphore signals are used for sending messages between ships in close proximity. The searchlight with shutter for signalling is used in sending a day visual signal to a ship at a considerable distance away, say five or ten miles.

At night the Ardois system is used between ships near together and also the occulating light method. Ships at a distance apart at night use the searchlight and the Very system. (Red and green stars fired in succession from an especially designed pistol. Red is a dot, green a dash, red-green an interval.)

In a fog sound signals are employed; the whistle, bell or oscillator.

For a full understanding of these signalling systems *and methods* "The Deck and Boat Book of the United *States Navy*" *should* be studied.

The following methods of signalling employ the dot-and-dash system.

(a) Wigwag........The signalman uses a signal flag on the end of a staff. A movement to the right is a dot, to the left a dash. A front is the interval.
(b) Ardois.........A string of double lanterns, red and white. Dot is a red light and dash a white light.
(c) Occulating light. Short flash a dot, long flash a dash. Steady display a front or interval.
(d) Searchlight.....Same as occulating light.
(e) Bell............Single stroke a dot, two rapid strokes a dash. Three strokes a front or interval.
(f) Whistle........Short toot a dot, two short toots, a dash, long blast a front.
(g) Oscillator......This is an electric method of producing sound to travel through the water. Short and long notes are used as in radio telegraphy.
(h) Submarine bell. A mechanical method of communicating by means of sound through the water as a medium instead of air. Single stroke a dot; double stroke a dash; three strokes a front.

The Dot-and-Dash Code.—It will be seen that the dot-and-dash code adopted by the navy comprises the alphabet and numerals of the International Morse Code, together with certain additional symbols and secondary meanings.

ALPHABET.

A -—	J -———	S ---
B —---	K —-—	T —
C —-—-	L -—--	U --—
D —--	M ——	V ---—
E -	N —-	W -——
F --—-	O ———	X —--—
G ——-	P -——-	Y —-——
H ----	Q ——-—	Z ——--
I --	R -—-	

NUMERALS.

1 -————	5 -----	8 ———--
2 --———	6 —----	9 ————-
3 ---——	7 ——---	0 —————
4 ----—		

ADDITIONAL SYMBOLS AND SECONDARY MEANINGS.

Cornet ————	Preparatory (L) -—--
Letters (follow) ———-	Annulling (N) —-
Interval or designator -—-—	Interrogatory (O) ———
Signals (follow) --——	Affirmative (P) -——-
Negative (K) —-—	

The *cornet* is a conventional signal calling upon all vessels within sight or hearing to answer the " Call."

Letters follow is a conventional symbol meaning that the next groups of dots and dashes are letters of the alphabet.

The interval or designator denotes the end of a word or sentence or it designates an object or name to follow.

Signals follow means that the next letters are signals to be found in the signal book.

Negative is the letter " K." Used to reply to a signal in the negative or to put a negative construction upon a sentence.

Preparatory is the letter " L "—denotes the order is preparatory only.

Annulling is the letter " N "—used to annul or cancel a message or a word of a message.

Interrogatory is the letter " O "—used to put a sentence in the interrogatory, or if used alone, understood as an inquiry.

Affirmative is the letter " P "—in answer to a question means " yes."

The Two-arm Semaphore.—Signals may be transmitted by the two-arm semaphore method, using either hand flags or machine With the machine a third arm or " indicator " is displayed on the right of the sender, as shown in the diagrams, to indicate which is the sender's right and which his left. Hand flags are from 12 to 15 inches square.

International Signals.—*Note.*—For complete detailed instructions as to the use of the International Code, see International Signal Book.

These are a set of signals which have been adopted by all nations in order that all ships may have a method of signalling to each other.

This code consists of 26 flags, burgees or pennants, *one for each letter in* the alphabet, and a code pennant, *which is also used* as an answering pennant.

In the International Code any particular hoist has the same meaning in each language.

When making a signal by this code look up the signal in the International Signal Book and bend on (in order, reading from up, down) the flags corresponding to the letters abreast this signal.

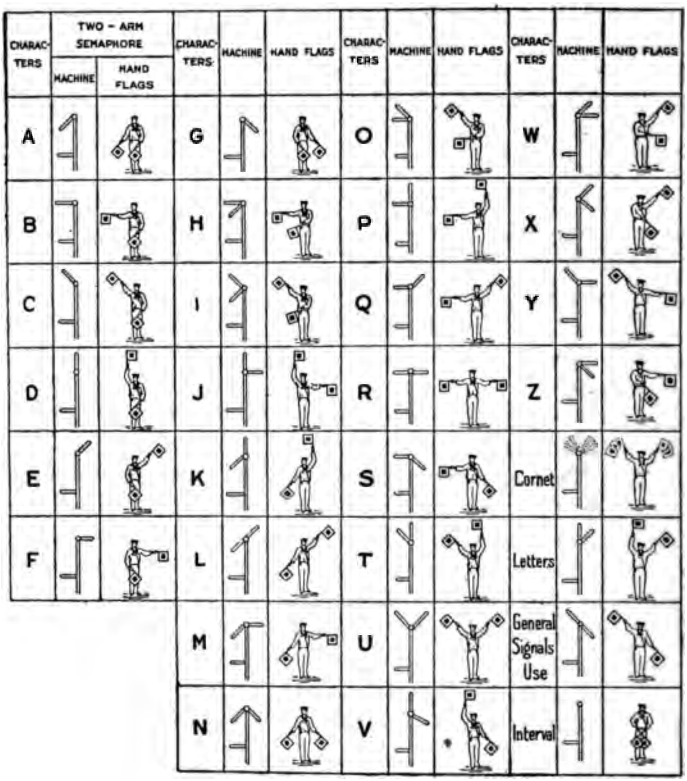
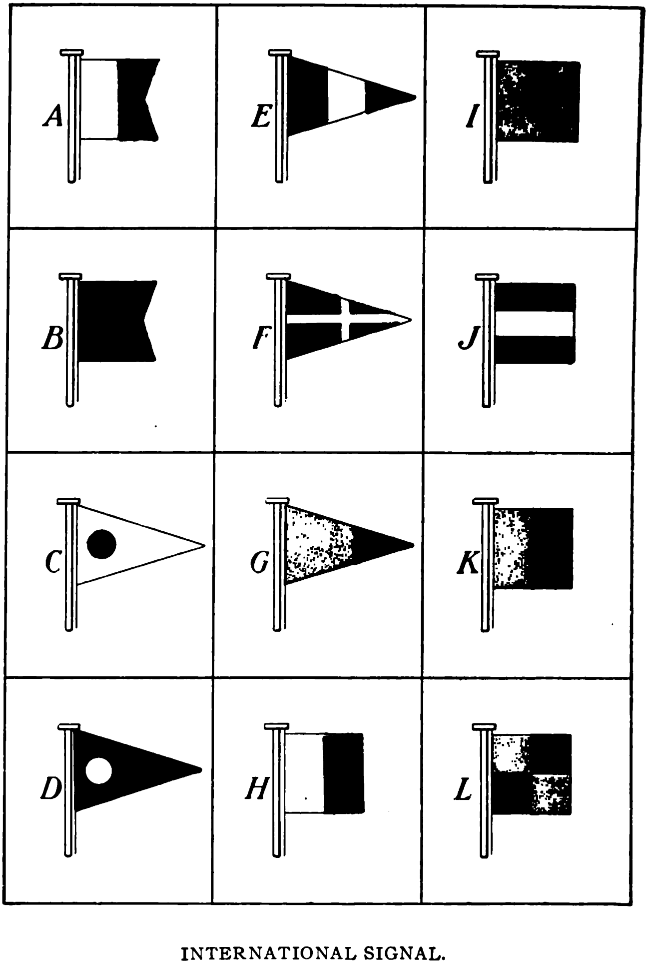


FIG 13.

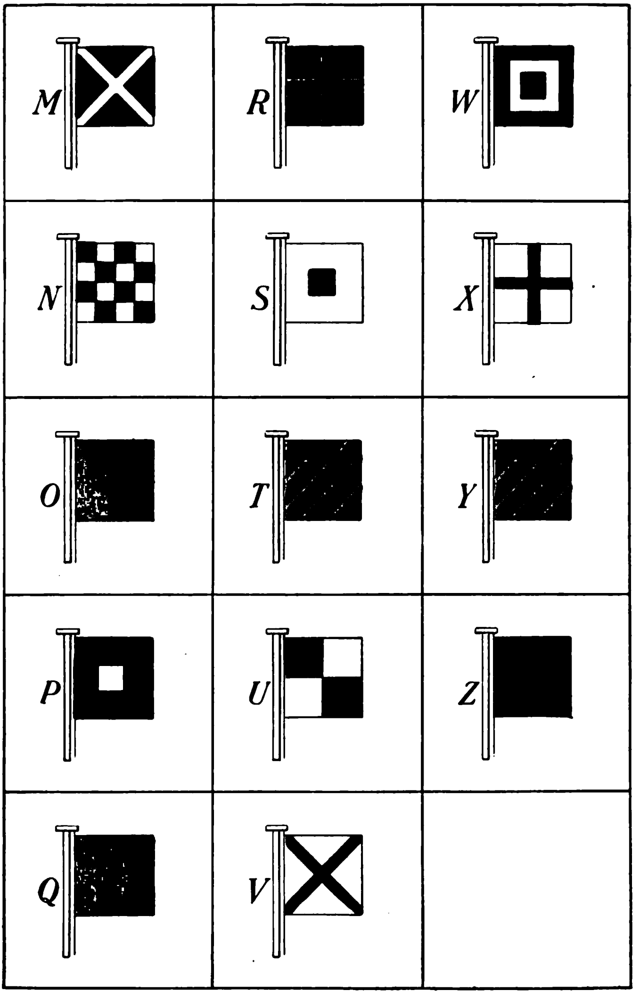
Hoist the code pennant under the ship's ensign and hoist the signal where it can best be seen.

If receiving a message the meaning will be found *abreast the letters* represented by the flags in the hoist.

The following instructions show in a general way the



INTERNATIONAL SIGNAL.



INTERNATIONAL SIGNAL.

manner in which the International Signal Book is divided and how the arrangement of the flags gives a distinctive character to the signal:

One-flag Signals.—B, C, D, L, P, Q, S, hoisted singly, have special significations. The code flag over each of the signal flags are signals of a general nature of most frequent use. Signal flags hoisted singly after numeral signal No. 1 refer to the numeral table, as do also two-flag signals with code flag under them.

Two-flag signals, without code flags, are urgent and important signals; with code flag over them are latitude and longitude, time, barometer and thermometer signals.

Three-flag signals express points of compass, money, weights and measures, and all ordinary signals required for communication.

Four-flag signals with a burgee (A or B) uppermost are geographical signals; with C uppermost are spelling or vocabulary signals; with G uppermost are names of men-of-war; with square flag uppermost are names of merchant vessels and are not in signal book. *Note.*—If the vessel flies a United States flag it will be found in list of United States merchant vessels. Naval vessels are usually not supplied with merchant lists of foreign nations and therefore the vessel cannot be generally made out; there can, however, be no doubt as to the meaning of a four-flag international signal with square flag on top.

International "Code Flag" and "Answering Pennant."—*Note.*—When used as the "code flag" it is to be hoisted under the ensign. When used as the "answering pennant" it is to be hoisted at the masthead or where best seen (see Fig. 14).

International Signal of Distress.—When a vessel is in distress and requires assistance from other vessels or from the shore, the following shall be the signals to be used or displayed by her, either together or separately:

In the daytime:

(1) A gun or other explosive signal fired at intervals *of about a minute.*

(2) The International code signal of distress indicated by NC.

(3) The distant signal, consisting of a square flag, having either above or below it a ball or anything resembling a ball.

(4) The distant signal, consisting of a cone, point upward, having either above it or below it a ball or anything resembling a ball.

(5) A continuous sounding with any fog-signal apparatus.

At night:

(1) A gun or other explosive signal fired at intervals of about a minute.

(2) Flames on the vessel (as from burning tar barrel, oil barrel, etc.)

(3) Rockets or shells, throwing stars of any color or description, fired one at a time at short intervals.

(4) A continuous sounding with any fog-signal apparatus.

International Signals for a Pilot.—The following signals, when used or displayed together, or separately, shall be deemed to be signals for a pilot:

In the daytime:

(1) The jack, to be hoisted at the fore.

(2) The International-code pilot signal indicated by PT.

(3) The International-code flag S, with or without the code pennant over it.

(4) The distant signal, consisting of a cone, pointed upward, having above it two balls or shapes resembling balls.

At night:

(1) The pyrotechnic light, commonly known as a blue light, every 15 minutes; or

(2) A bright white light, flashed or shown at short or frequent intervals just above the bulwark for about a minute at a time.

Signals of Life-saving Service.—The following sig-

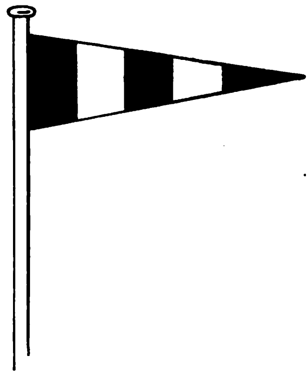


FIG. 14.
INTERNATIONAL "CODE FLAG" AND ANSWERING PENNANT.

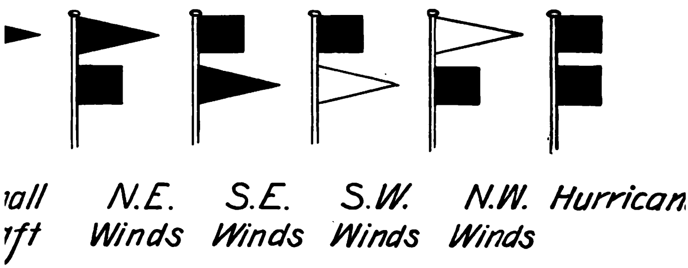


FIG. 15.
HURRICANE WARNING.

nals, approved by the International Marine Conference, convened at Washington in October, 1889, have been adopted by the U. S. Life-saving Service and will be used and recognized by the officers and employés as occasion may require.

Upon the discovery of a wreck by night the life-saving force will burn a red pyrotechnic light or a red rocket to signify: "You are seen; assistance will be given as soon as possible."

A red flag waved on shore by day, or a red light, red rocket, or red Roman candle displayed by night, will signify: "Haul away."

A white flag waved on shore by day, or white light slowly swung back and forth, or a white rocket, or white Roman candle fired by night, will signify: "Slack away."

Two flags, a white and red, waved at the same time on shore by day, or two lights, a white and a red, slowly swung at the same time, or a blue pyrotechnic light burned by night, will signify: "Do not attempt to land in your boats. It is impossible."

A man on shore beckoning by day, or two torches burning near together at night, will signify: "This is the best place to land."

Any of these signals may be answered from the vessel as follows: In the daytime, by waving a flag, handkerchief, a hat, or even the hand; at night, by firing a rocket, a blue light, or a gun, or by showing a light over the ship's gunwale for a short time and then concealing it.

U. S. Storm Signals.—The various civilized nations of the world give warning to mariners of the approach of storms. These notices are received by telegraph at various stations along the coast, and indicate the approach of storms and the expected direction of the wind. In the United States the system of weather signals is very complete, information of the approach of storms being received from various stations in the United States, and even throughout the West Indies. These warnings are published at the various seaports by the display of flags by

day and by lanterns at night, also by bulletins and reports furnished to newspapers. Every effort is made by the Weather Bureau of the United States Department of Agriculture to give these warnings as early as possible at all points where they may be of service to mariners and others.

Storm signals are displayed by the United States Weather Bureau at 142 stations on the Atlantic and Gulf coasts and at 46 stations on the Pacific coast.

Small-craft Warnings.—A red pennant indicates that moderately strong winds are expected.

Storm Warnings.—A red flag, with a black centre, indicates that a storm of marked violence is expected.

The pennants displayed with the flags indicate the direction of the wind: red, easterly; white, westerly. The pennant above the flag indicates that the wind is expected to blow from the northerly quadrants; below, from southerly quadrants.

By night a red light indicates easterly winds, and a white light below a red light, westerly winds.

Hurricane Warnings.—Two red flags, with black centres, displayed one above the other, indicates the expected approach of a tropical hurricane, or one of those extremely severe and dangerous storms which occasionally move across the Lakes and northern Atlantic coast.

Small-craft and hurricane warnings are not displayed at night.

The Officer of the Deck.—The duties of the officer of the deck are very fully laid down in the U. S. Navy Regulations and Naval Instructions; so fully indeed that an officer of the deck will render himself liable to court-martial at every turn unless he takes the trouble to study them carefully. Remember these regulations are the epitomized experience of generations of naval officers past and gone. Do not take them too literally, but the spirit should be accepted and followed.

Space does not permit giving all the varied duties of this important position; those desiring to study the officer

of the deck in port and at sea will find it in the Navy Regulations in compact enough form for reference.

At sea, with the fleet, the duties of the officer of the deck have an added significance. In manœuvres and in station keeping the officer of the deck carries a responsibility requiring experience and judgment. A few hints will be here given; they are not complete or final but may aid the novice to a general understanding of the situation.

If all goes well, even in manœuvres, a green officer will get along. The unexpected is what an officer of the deck must be ready to meet; for therein lies danger, not only to your own ship but to others.

Hints to Officers of the Deck.—(*a*) Look out for "break down" on ship ahead. Make up your mind just what you will do if you should see her suddenly sheer out of the formation. Remember it is always wiser to go astern of rather than ahead of a ship with headway on.

(*b*) Do not overlook the possibility of a breakdown on board your own ship. Your helmsman may report at any time "the helm's jammed, sir." Use your engines at once; of course inquire the angle the helm or rudder is. It is perfectly simple to steer with engines. Get out of the formation as soon as you can.

(*c*) Column is the customary formation. One vessel dead astern of another. Keeping accurate position is the duty of the officer of the deck. There's a knack in it that will come to most through practice. There are several things worth remembering. A battleship requires some minutes to respond to an increase or a decrease of speed. Do not be impatient and overdo the remedy.

Suppose you are in a ship that requires six revolutions for one knot at cruising speed. One knot is 33.3 yards a minute. Your stadimeter shows you are one hundred yards behind your position, measured from the foremast of the ship ahead. You want to close up as soon as possible but you do not desire to see-saw on the job. If you *ring up six revolutions* faster, it will take three minutes *before you are in position.* If you ring up twelve revo-

lutions faster you will be in position in one-half the time or one and one-half minutes. Suppose it is imperative that you be closed up in thirty seconds, then ring up thirty-six revolutions faster and take it off in thirty seconds. This may carry you a trifle beyond, but not enough to bother you. As a rule the engineers will not be prepared to give you six knots faster, so you will have to content yourself in taking a longer time to reach your position. The same remarks hold for losing distance. Remember there is a ship behind you—be charitable and indicate to him in case you make a wide change in speed.

In turning correctly your jackstaff should be just outside of the after-turret of the vessel next ahead. Remember when the ship ahead puts her helm over, or rudder over, as it is called in the American navy, she slows to about 60 per cent. of her previous speed, due to the effect of the turning; consequently your ship will close up on her rapidly. Good turns are matters of good judgment. Watch the wake of the next ahead and try to put the rudder over in exactly the same spot. You can easily see by the " kick " in the water where her rudder went over. You know how long it takes to put your rudder over—use judgment; in some ships bring the kick abaft the bridge. In some cases when the ball on the jackstaff crosses the wake of the next ahead is the time to put the helm over. After putting it over continue the turn. If you right the helm (rudder), or even ease it, when pointing at the ship ahead when she is turning, your ship will at once increase its speed and you may arrive dangerously or at least alarmingly close to her before you are around. Right the helm (rudder) when about two points from the new course and meet her at one point, depending of course upon speed and amount of rudder given. There can be no exact rules for this; experience *on board* each ship alone can insure good results. If the *turn is through* more than eight points it is not safe to *turn inside of* the next ahead. Each individual ship must

be studied—officers should in time learn to turn their ship exactly in the wake of the next ahead in column.

(*d*) *Line.*—Ships abreast on parallel courses; the course is at right angles to the bearing of ships in the line.

Keeping position in line, the most difficulty is experienced in maintaining the bearing. Keeping the correct distance is quite easy. When in line, vessels being abeam of each other, changes of speed affect the distance very

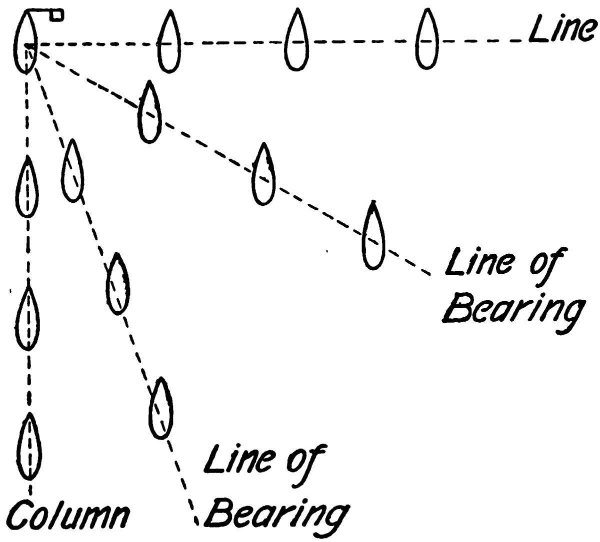


FIG. 16.

slightly. The usual rule in keeping position in line is to alter course a degree at a time, in or out, depending whether you desire to close in or open out. Of course to correct the bearing the speed must be changed.

(*e*) *Line of Bearing.*—Ships are on parallel courses, the line through ships being anywhere between parallel to course and at right angles to it; the former is column and *the latter is* line, so line of bearing is any formation *between the two.*

Here are rules almost universally followed in keeping position in formation:

(*a*) In keeping position in any formation from column to line of bearing 45 degrees, preserve proper distance by using the engines and the correct bearing by using the rudder.

(*b*) In keeping position in any formation from line to line of bearing 45 degrees, preserve proper distance by using rudder and correct bearing with engines.

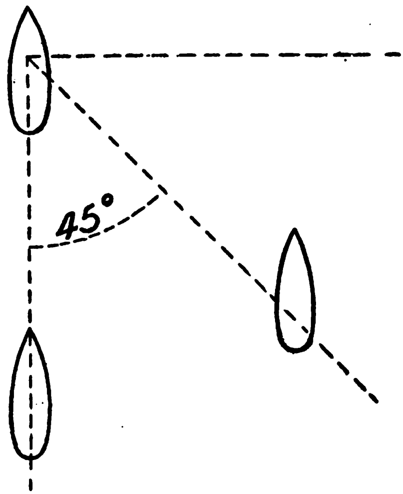


FIG. 17.

However, in both (*a*) and (*b*) it will be found that except in column, any error either in distance or bearing can be corrected only by using both engines and rudder.

(*f*) *The Mooring Board.*—This is so very simple and is such a splendid method of promptly and unhesitatingly going direct to an anchorage that it is a pity more use is not made of it. The foremast of the ship being angled *upon* is plotted at the centre of the diagram. The distance from foremast to bow is then laid off and then the distance of bow to anchor. Ship being angled upon will

on request send by signal her heading, amount of chain out and whether chain is slack or taut.

Then having been given by the senior officer at the anchorage the position, where to anchor, from a designated ship, draw a line from the position, plotted, of her anchor to where your anchor must be dropped. This is shown in sketch (Fig. 18), bearing is *b*, distance *d*. Now stand in toward ship from whom you are to take distance, get frequent bearings and distances and head ship for position of your plotted anchor. The remainder of the

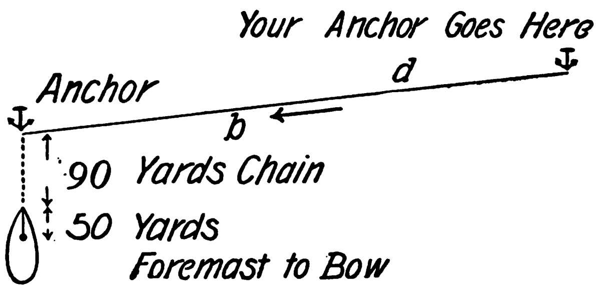


FIG. 18.

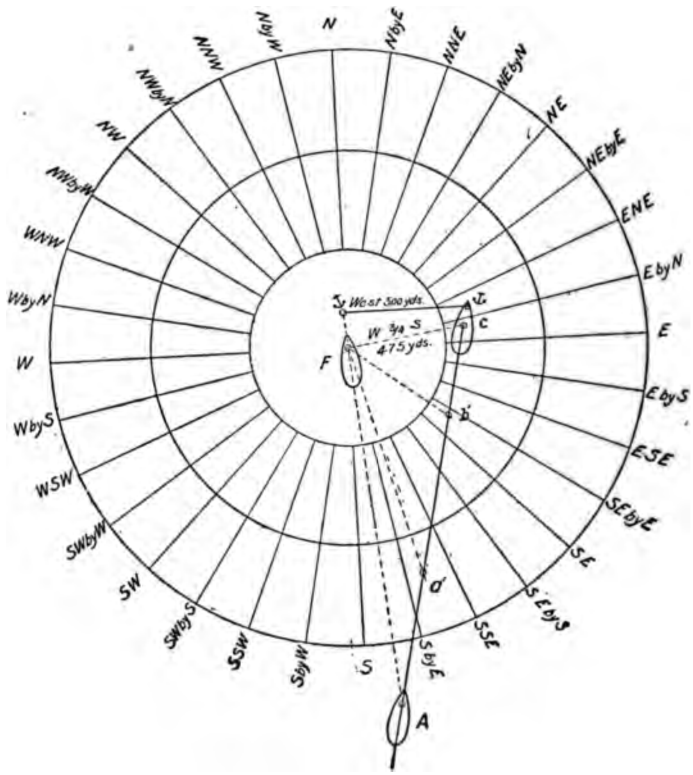
problem is shown on the sketch (Fig. 19). Mooring board diagrams are available on board any naval ship.

(*g*) Do not take anything for granted. Be sure on all points. Do not hesitate when in doubt to call the navigator or captain or both. Their rest is not as important as the ship's safety, be they ever so crusty.

(*h*) Read the Naval Regulations and Instructions carefully, not once but often. You will find they are a splendid reminder, and show you how very important a personage you are when officer of the deck.

(*i*) While officer of the deck, when everything is serene and you are endeavoring to keep yourself awake, do not use unprofitable methods of stimulating your brain; *picture to yourself* the many things that might suddenly *happen to change* the prevailing calm and then rehearse

Mooring Board
Diagram



Heading of F N½W
Foremast to Bow 50 yards
Bow to anchor 90 yards
(45 Fathoms of Chain)

Bearing is taken from Foremast
Ship A is ordered to Anchor
500yds with Ship F bearing West

At A	bearing F N½W	distance	1450 yards
At (a)	bearing F NbyW½W	distance	950 yards
At (b)	bearing F NW ¾W	distance	500 yards
At (c) ⚓	bearing F W¾S	distance	475 yards

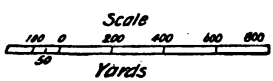


FIG. 19.

to yourself what your part in each will be. You will find this a better stimulant than coffee.

(*j*) Study the signal books and learn the codes. You cannot imagine how much more at home you will feel if you can actually read every signal being sent as readily as if you were merely overhearing conversations.

(*k*) Never permit a tactical signal to be hoisted in answer to one until you know its meaning and how to execute it.

(*l*) In cases of emergency, remember unless the captain is on deck with you, that its up to you and no one else. Do not send to ask permission from the captain—act according to your best judgment and take the responsibility for having done correctly afterward. If there is time, there's no objection to letting the captain know what is going on, but that is really a secondary matter.

(*m*) In lowering lifeboats, lower lee boat; never lower boat with stern-board on ship. Make sure signalmen keep watch on man in water and hoist appropriate signals to direct the lifeboat toward the man.

(*n*) If in doubt about the rule of the road in a case, you cannot go far wrong by keeping to the right. A steamer towing has no privileges; she must obey the rules of the road equally with steamers having no tow. However, if you meet a tow, watch out, for the tow may not know that he has no special rights.

(*o*) Do not get into the habit of mind of considering the officer of the deck of another ship will do the correct thing always. Be especially on your guard in meeting a tramp steamer. There may be brains on her bridge but again there may not.

(*p*) Always take a bearing of a steamer crossing. If the bearing changes slowly or does not change at all, there is danger of both ships maintaining their course. When changing course to avoid danger, if conditions admit, make a change wide enough to be seen without chance of doubt or misunderstanding. Do not forget the rule about blowing the whistle when altering course.

(*q*) Collision mats are often useful after being rammed, but they must be gotten in place carefully and this takes much time. The thing to do first is to close all water-tight doors and hatches and thus localize the inrushing water. Then see the boats ready for getting out. If injury can be localized there will be time enough to get the collision mat over the hole.

(*r*) Train the junior officers to relieve you of most of the details of station keeping so that you can keep your head clear for the important things. He cannot relieve you of any responsibility, so remember that.

(*s*) In a fog never leave the forepart of the bridge. See that all ears on the bridge are employed. At night don't go into the chart house unless for something imperative, and if you do, let your junior take your place and inform him when you return. When with the fleet, never leave the bridge without turning over to some one who will be capable of acting or informing you in event of an emergency.

(*t*) See to things yourself; if you are responsible it is best to come to grief by your error rather than through the error of some one else. If you must trust any one, be sure of the one you trust.

(*u*) Do not raise your voice above that necessary to carry the order. Do not permit others to pass a word for you. Keep each man in his place; that is, show them that you are the boss, not by reprimands or fault-finding but by quiet example. Study your duties and endeavor to be always right. Do not be too self-reliant. It pleases subordinates to feel that they are useful and that you will trust them.

PILOT RULES—UNITED STATES WATERS

In the following rules every steam-vessel which is under sail and not under steam is to be considered a *sailing-vessel,* and every vessel under steam, *whether under sail or not,* is to be considered a steam-vessel.

The word "steam-vessel" shall include any vessel propelled by machinery.

A vessel is "underway," within the meaning of these rules, when she is not at anchor, or made fast to the shore, or aground.

Rules Concerning Lights and So Forth:

The word "visible," in these rules, when applied to lights, shall mean visible on a dark night with a clear atmosphere.

ARTICLE 1. The rules concerning lights shall be complied with in all weathers from sunset to sunrise, and during such time no other lights which may be mistaken for the prescribed lights shall be exhibited.

ART. 2. A steam-vessel when under way shall carry: (*a*) On or in front of the foremast, or, if a vessel without a foremast, then in the forepart of the vessel, a bright white light so constructed as to show an unbroken light over an arc of the horizon of twenty points of the compass, so fixed as to throw the light ten points on each side of the vessel, namely, from right ahead to two points abaft the beam on either side, and of such character as to be visible at a distance of at least five miles.

(*b*) On the starboard side a green light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the starboard side, and of such a character as to be visible at a distance of at least two miles.

(*c*) On the port side a red light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the port side, and of such character as to be visible at a distance of at least two miles.

(*d*) The said green and red side-lights shall be fitted with inboard screens projecting at least three feet forward from the light, so as to prevent these lights from being seen across the bow.

(*e*) A seagoing steam-vessel when under way may carry an additional white light similar in construction to the light mentioned in subdivision (*a*). These two lights shall be so placed in line with the keel that one shall be at least fifteen feet higher than the other, and in such a position with reference to each other that the lower light shall be forward of the upper one. The vertical distance between these lights shall be less than the horizontal distance.

(*f*) All steam-vessels (except sea-going vessels and ferry-boats) shall carry in addition to green and red lights required by article two (*b*), (*c*), and screens as required by article two, (*d*), a central range of two white lights; the after-light being carried at an elevation at least fifteen feet above the light at the head of the vessel. The head-light shall be so constructed as to show an unbroken light through twenty points of the compass, namely, from right ahead to two points abaft the beam on either side of the vessel, and the after-light so as to show all around the horizon.

ART. 3. A steam-vessel when towing another vessel shall, in addition to her side-lights, carry two bright white lights in a vertical line one over the other, not less than three feet apart, and when towing more than one vessel shall carry an additional bright white light three feet above or belo such lights, if the length of the tow measuring from the stern of the towing vessel to the stern of the last vessel towed exceeds six hundred feet. Each of these lights shall be of the same construction and character, and shall be carried in the same position as the white light mentioned in article two (*a*) or the after-range light mentioned in article two (*f*).

Such steam-vessel may carry a small white light abaft the funnel or aftermast for the vessel towed to steer by, but such light shall not be visible forward of the beam.

ART. 5. A sailing-vessel under way or being towed shall carry the same lights as are prescribed by article two for a steam-vessel under way, with the exception of

the white lights mentioned therein, which they shall never carry.

ART. 6. Whenever, as in the case of vessels of less than ten gross tons under way during bad weather, the green and red side-lights cannot be fixed, these lights shall be kept at hand, lighted and ready for use; and shall, on the approach of or to other vessels, be exhibited on their respective sides in sufficient time to avoid collision, in such manner as to make them most visible, and so that the green light shall not be seen on the port side nor the red light on the starboard side, nor, if practicable more than two points abaft the beam on their respective sides. To make the use of these portable lights more certain and easy the lanterns containing them shall each be painted outside with the color of the light they respectively contain, and shall be provided with proper screens.

ART. 7. Rowing boats, whether under oars or sail, shall have ready at hand a lantern showing a white light which shall be temporarily exhibited in sufficient time to prevent collision.

ART. 8. Pilot-vessels when engaged on their station on pilotage duty shall not show the lights required for other vessels, but shall carry a white light at the masthead, visible all around the horizon, and shall also exhibit a flare-up light or flare-up lights at short intervals, which shall never exceed fifteen minutes.

That a steam pilot-vessel, when engaged on her station on pilotage duty and in waters of the United States, and not at anchor, shall, in addition to the lights required for all pilot boats, carry at a distance of eight feet below her white masthead light a red light, visible all around the horizon and of such a character as to be visible on a dark night with a clear atmosphere at a distance of at least two miles, and also the colored side-lights required to be carried by vessels when under way.

When engaged on her station on pilotage duty and in *waters of the* United States, and at anchor, she shall *carry in addition* to the lights required for all pilot boats

the red light above mentioned, but not the colored side-lights.

When not engaged on her station on pilotage duty, she shall carry the same lights as other steam vessels.

On the near approach of or to other vessels pilot-vessels other than steam pilot-vessels shall have their side-lights lighted, ready for use, and shall flash or show them at short intervals, to indicate the direction in which they are heading, but the green light shall not be shown on the port side nor the red light on the starboard side.

A pilot-vessel of such a class as to be obliged to go alongside of a vessel to put a pilot on board may show the white light instead of carrying it at the masthead, and may, instead of the colored lights above mentioned, have at hand, ready for use, a lantern with a green glass on the one side and a red glass on the other, to be used as prescribed above.

Pilot-vessels, when not engaged on their station on pilotage duty, shall carry lights similar to those of other vessels of their tonnage.

ART. 9. (*a*) Fishing-vessels of less than ten gross tons, when under way and when not having their nets, trawls, dredges, or lines in the water, shall not be obliged to carry the colored side-lights; but every such vessel shall, in lieu thereof, have ready at hand a lantern with a green glass on one side and a red glass on the other side, and on approaching to or being approached by another vessel such lantern shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side.

(*b*) All fishing-vessels and fishing-boats of ten gross tons or upward, when under way and when not having their nets, trawls, dredges, or lines in the water, shall carry and show the same lights as other vessels under way.

(*c*) All vessels, when trawling, dredging, or fishing with any kind of drag-nets or lines, shall exhibit, from some part of the vessel where they can be best seen, two

lights. One of these lights shall be red and the other shall be white. The red light shall be above the white light, and shall be at a vertical distance from it of not less than six feet and not more than twelve feet; and the horizontal distance between them, if any, shall not be more than ten feet. These two lights shall be of such a character and contained in lanterns of such construction as to be visible all around the horizon, the white light a distance of not less than three miles and the red light of not less than two miles.

(*d*) Rafts, or other water craft not herein provided for, navigating by hand power, horse power, or by current of the river, shall carry one or more good white lights, which shall be placed in such manner as shall be prescribed by the Board of Supervising Inspectors of Steam Vessels.

ART. 10. A vessel which is being overtaken by another, except a steam-vessel with an after range-light showing all around the horizon, shall show from her stern to such last-mentioned vessel a white light or a flare-up light.

ART. 11. A vessel under one hundred and fifty feet in length when at anchor shall carry forward, where it can best be seen, but at a height not exceeding twenty feet above the hull, a white light in a lantern so constructed as to show a clear, uniform, and unbroken light visible all around the horizon at a distance of at least one mile.

A vessel of one hundred and fifty feet or upwards in length when at anchor shall carry in the forward part of the vessel, at a height of not less than twenty and not exceeding forty feet above the hull, one such light, and at or near the stern of the vessel, and at such a height that it shall be not less than fifteen feet lower than the forward light, another such light.

The length of a vessel shall be deemed to be the length appearing in her certificate of registry.

ART. 12. Every vessel may, if necessary, in order to *attract attention,* in addition to the lights which she is

by these rules required to carry, show a flare-up light or use any detonating signal that cannot be mistaken for a distress signal.

Art. 13. Nothing in these rules shall interfere with the operation of any special rules made by the government of any nation with respect to additional station and signal lights for two or more ships of war or for vessels sailing under convoy, or with the exhibition of recognition signals adopted by shipowners, which have been authorized by their respective governments, and duly registered and published.

Art. 14. A steam-vessel proceeding under sail only, but having her funnel up, may carry in daytime, forward, where it can best be seen, one black ball or shape two feet in diameter.

Sound Signals for Fog, and So Forth:

Art. 15. All signals prescribed by this article for vessels under way shall be given:

1. By "steam-vessels" on the whistle or siren.

2. By "sailing-vessels" and "vessels towed" on the foghorn.

The words "prolonged blast" used in this article shall mean a blast of from four to six seconds' duration.

A steam-vessel shall be provided with an efficient whistle or siren, sounded by steam or by some substitute for steam, so placed that the sound may not be intercepted by any obstruction, and with an efficient foghorn; also with an efficient bell. A sailing-vessel of twenty tons gross tonnage or upward shall be provided with a similar foghorn and bell.

In fog, mist, falling snow, or heavy rainstorms, whether by day or night, the signals described in this article shall be used as follows, namely:

(*a*) A steam-vessel under way shall sound, at intervals of not more than one minute, a prolonged blast.

(*b*) A sailing-vessel under way shall sound, at intervals of not more than one minute, when on the starboard tack, one blast; when on the port tack, two blasts in suc-

cession, and when with the wind abaft the beam, three blasts in succession.

(*c*) A vessel at anchor shall, at intervals of not more than one minute, ring the bell rapidly for five seconds.

(*d*) A steam-vessel when towing, shall, instead of the signals prescribed in subdivision (*a*) of this article, at intervals of not more than one minute, sound three blasts in succession, namely, one prolonged blast followed by two short blasts. A vessel towed may give this signal and she shall not give any other.

(*e*) All rafts or other water craft, not herein provided for, navigating by hand power, horse power, or by the current of the river, shall sound a blast of the fog-horn, or equivalent signal, at intervals of not more than one minute.

Speed of Ships to be Moderate in Fog, and So Forth.—ART. 16. Every vessel shall, in a fog, mist, falling snow, or heavy rainstorms, go at a moderate speed, having careful regard to the existing circumstances and conditions.

A steam-vessel hearing, apparently forward of her beam, the fog-signal of a vessel the position of which is not ascertained shall, so far as the circumstances of the case admit, stop her engines, and then navigate with caution until danger of collision is over.

Steering and Sailing Rules—Preliminary —Risk of Collision.—Risk of collision can, when circumstances permit, be ascertained by carefully watching the compass bearing of an approaching vessel. If the bearing does not appreciably change, such risk should be deemed to exist.

ART. 17. When two sailing-vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other as follows, namely:

(*a*) A vessel which is running free shall keep out of the way of a vessel which is close-hauled.

(*b*) A vessel which is close-hauled on the port tack shall keep out of the way of a vessel which is close-hauled on the starboard tack.

(*c*) When both are running free, with the wind on different sides, the vessel which has the wind on the port side shall keep out of the way of the other.

(*d*) When both are running free, with the wind on the same side, the vessel which is to the windward shall keep out of the way of the vessel which is to the leeward.

(*e*) A vessel which has the wind aft shall keep out of the way of the other vessel.

ART. 18. Rule I. When steam-vessels are approaching each other head and head, that is, end on, or nearly so, it shall be the duty of each to pass on the port side of the other; and either vessel shall give, as a signal of her intention, one short and distinct blast of her whistle, which the other vessel shall answer promptly by a similar blast of her whistle, and thereupon such vessel shall pass on the port side of each other. But if the courses of such vessels are so far on the starboard of each other as not to be considered as meeting head and head, either vessel shall immediately give two short and distinct blasts of her whistle, which the other vessel shall answer promptly by two similar blasts of her whistle, and they shall pass on the starboard side of each other.

The foregoing only applies to cases where vessels are meeting end on or nearly end on, in such manner as to involve risk of collision; in other words, to cases in which, by day, each vessel sees the masts of the other in a line, or nearly in a line, with her own, and by night to cases in which each vessel is in such a position as to see both the sidelights of the other.

It does not apply by day to cases in which a vessel sees another ahead crossing her own course, or by night to cases where the red light of one vessel is opposed to the red light of the other, or where the green light of one vessel is opposed to the green light of the other, or where the red light without a green light or a green light without a red light, is seen ahead, or where both green and red lights are seen anywhere but ahead.

RULE III. If, when steam-vessels are approaching

each other, either fails to understand the course or intention of the other, from any cause, the vessel in doubt shall immediately signify the same by giving several short and rapid blasts, not less than four, of the steam whistle.

RULE V. Whenever a steam-vessel is nearing a short bend or curve in the channel, where, from the height of the banks or other cause, a steam-vessel approaching from the opposite direction cannot be seen for a distance of half a mile, such steam-vessel, when she shall have arrived within half a mile of such curve or bend, shall give a signal by one long blast of the steam whistle, which signal shall be answered by a similar blast, given by an approaching steam-vessel that may be within hearing. Should such signal be so answered by a steam-vessel upon the farther side of such bend, then the usual signals for meeting and passing shall immediately be given and answered; but, if the first alarm signal of such vessel be not answered, she is to consider the channel clear and govern herself accordingly.

When steam-vessels are moved from their docks or berths, and other boats are liable to pass from any direction toward them, they shall give the same signal as in the case of vessels meeting at a bend, but immediately after clearing the berths so as to be fully in sight they shall be governed by the steering and sailing rules.

RULE VIII. When steam vessels are running in the same direction, and the vessel which is astern shall desire to pass on the right or starboard hand of the vessel ahead, she shall give one short blast of the steam whistle, as a signal of such desire, and if the vessel ahead answers with one blast, she shall put her helm to port; or if she shall desire to pass on the left or port side of the vessel ahead, she shall give two short blasts of the steam whistle as a signal of such desire, and if the vessel ahead answers with two blasts, shall put her helm to starboard; or if the vessel ahead does not think it safe for the vessel astern to attempt *to pass at that* point, she shall immediately signify *the same by giving* several short and rapid blasts of the

steam whistle, not less than four, and under no circumstances shall the vessel astern attempt to pass the vessel ahead until such time as they have reached a point where it can be safely done, when said vessel ahead shall signify her willingness by blowing the proper signals. The vessel ahead shall in no case attempt to cross the bow or crowd upon the course of the passing vessel.

RULE IX. The whistle signals provided in the rules under this article for steam vessels meeting, passing, or overtaking, are never to be used except when steamers are in sight of each other, and the course and position of each can be determined in the daytime by a sight of the vessel itself, or by night by seeing its signal lights. In fog, mist, falling snow, or heavy rainstorms, when vessels cannot see each other, fog-signals only must be given.

ART. 19. When two steam-vessels are crossing, so as to avoid risk of collision, the vessel which has the other on her starboard side shall keep out of the way of the other.

ART. 20. When a steam-vessel and a sailing-vessel are proceeding in such directions as to involve risk of collision, the steam-vessel shall keep out of the way of the sailing-vessel.

ART. 21. Where, by any of these rules, one of the two vessels is to keep out of the way, the other shall keep her course and speed.

ART. 22. Every vessel which is directed by these rules to keep out of the way of another vessel shall, if the circumstances admit, avoid crossing ahead of the other.

ART. 23. Every steam-vessel which is directed by these rules, to keep out of the way of another vessel shall, on approaching her, if necessary, slacken her speed or stop or reverse.

ART. 24. Notwithstanding anything contained in these rules every vessel, overtaking another, shall keep out of the way of the overtaken vessel.

Every vessel coming up with another vessel from any *direction* more than two points abaft her beam, that is,

in such a position, with reference to the vessel which she is overtaking that at night she would be unable to see either of that vessel's side-lights, shall be deemed to be an overtaking vessel; and no subsequent alteration of the bearing between the two vessels shall make the overtaking vessel a crossing vessel within the meaning of these rules, or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear.

As by day the overtaking vessel cannot always know with certainty whether she is forward of or abaft this direction from the other vessel she should, if in doubt, assume that she is an overtaking vessel and keep out of the way.

ART. 25. In narrow channels every steam-vessel shall, when it is safe and practicable, keep to that side of the fair-way or mid-channel which lies on the starboard side of such vessel.

ART. 26. Sailing-vessels under way shall keep out of the way of sailing-vessels or boats fishing with nets, or lines, or trawls. This rule shall not give to any vessel or boat engaged in fishing the right of obstructing a fair-way used by vessels other than fishing-vessels or boats.

ART. 27. In obeying and construing these rules due regard shall be had to all dangers of navigation and collision, and to any special circumstances which may render a departure from the above rules necessary in order to avoid immediate danger.

Sound Signals for Vessels in Sight of One Another.—ART. 28. When vessels are in sight of one another a steam-vessel under way whose engines are going at full speed astern shall indicate the fact by three short blasts on the whistle.

No Vessel Under Any Circumstances to Neglect Proper Precautions.—ART. 29. Nothing in these rules shall exonerate any vessel, or the owner or master or crew thereof, from the consequences of any neglect to carry lights or signals, or of any neglect to keep a proper look-out, or of the neglect of any precaution which may

required by the ordinary practice of seamen, or by the special circumstances of the case.

ART. 30. The exhibition of any light on board of a vessel of war of the United States or a revenue cutter may be suspended whenever, in the opinion of the Secretary of the Navy, the commander-in-chief of a squadron, or the commander of a vessel acting singly, the special character of the service may require it.

Rules for Dredges Which are Held in Stationary Position by Spuds or Moorings.—Dredges which are held in stationary position by moorings or spuds shall display by day two red balls not less than 2 feet in diameter and carried in a vertical line not less than 3 feet nor more than 6 feet apart, and at least 15 feet above the deck-house and in such a position where they can be seen from all directions. By night they shall display a white light at each corner, not less than 6 feet above the deck, and in addition thereto there shall be displayed in a position where they may best be seen from all directions two red lights carried in a vertical line not less than 3 feet nor more than 6 feet apart, and not less than 15 feet above the deck. When scows are moored alongside a dredge in the foregoing situation they shall display a white light on each outboard corner, not less than 6 feet above the deck.

Rule for Self-propelling Suction Dredges Underway with Their Suctions on the Bottom.—Self-propelling suction dredges underway with their suction on the bottom shall display by day the same signals as are used to designate any steamer not under control; that is to say, two black balls not less than 2 feet in diameter and carried not less than 15 feet above the deck-house, and where they may best be seen from all directions.

By night they shall carry, in addition to the regular running lights, two red lights of the same character as the masthead light, in the same vertical plane and underneath the masthead light, the red lights to be not less than 3 feet *nor more than* 6 feet apart and the upper red light to be *not less than* 4 feet and not more than 6 feet below the

white masthead light, and on or near the stern two red lights in the same vertical plane not less than 4 feet nor more than 6 feet apart, to show through 4 points of the compass; that is, from right astern to 2 points on each quarter.

Rule Prohibiting Unnecessary Sounding of the Steam Whistle (authority: Act of Congress approved February 8, 1907).—The Board of Supervising Inspectors, at their annual meeting of January, 1907, adopted the following rule:

Unnecessary sounding of the steam whistle is prohibited within any harbor limits of the United States. Whenever any licensed officer in charge of any steamer authorizes or permits such unnecessary whistling, upon conviction thereof before any board of inspectors having jurisdiction, such officer shall be suspended from acting under his license as the inspectors trying the case may deem proper.

Rule Relating to the Use of Searchlights.—Any master or pilot of any steam-vessel who shall flash or cause to be flashed the rays of the searchlight into the pilot-house of a passing vessel shall be deemed guilty of misconduct and shall be liable to have his license suspended or revoked.

An Act to Amend Laws for Preventing Collisions of Vessels and to Regulate Equipment of Certain Motor Boats on the Navigable Waters of the United States.—Be it enacted by the Senate and House of Representatives of the United States of America in congress assembled, That the words "motor boat" where used in this act shall include every vessel propelled by machinery and not more than sixty-five feet in length, except tug-boats and tow-boats propelled by steam. The length shall be measured from end to end over the deck, excluding sheer: *Provided,* That the engine, boiler, or other operating machinery shall be subject to inspection by the local inspectors of steam-vessels, and to their approval of the design thereof, on all said motor boats.

which are more than forty feet in length, and which are propelled by machinery driven by steam.

SEC. 2. That motor boats subject to the provisions of this Act shall be divided into classes as follows:

Class One.—Less than twenty-six feet in length.

Class Two.—Twenty-six feet or over and less than forty feet in length.

Class Three.—Forty feet or over and not more than sixty-five feet in length.

SEC. 3. That every motor boat in all weathers from sunset to sunrise shall carry the following lights, and during such time no other lights which may be mistaken for those prescribed shall be exhibited:

(*a*) Every motor boat of class one shall carry the following lights:

First.—A white light aft to show all around the horizon.

Second.—A combined lantern in the forepart of the vessel and lower than the white light aft showing green to starboard and red to port, so fixed as to throw the light from right ahead to two points abaft the beam on their respective sides.

(*b*) Every motor boat of classes two and three shall carry the following lights:

First.—A bright white light in the forepart of the vessel as near the stem as practicable, so constructed as to show an unbroken light over an arc of the horizon of 20 points of the compass, so fixed as to throw the light 10 points on each side of the vessel, from right ahead to two points abaft the beam on either side. The glass or lens shall be of not less than the following dimensions:

Class Two.—Nineteen square inches.

Class Three.—Thirty-one square inches.

Second.—A white light aft to show all around the horizon.

Third.—On the starboard side a green light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw

the light from right ahead to two points abaft the beam on the starboard side. On the port side a red light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the port side. The glasses or lenses in the said side-lights shall be not less than the following dimensions on motor-boats of:

Class Two—Sixteen square inches.

Class Three.—Twenty-five square inches.

On and after July 1, 1911, all glasses or lenses prescribed by paragraph (*b*) of section three shall be fresnel or fluted. The said lights shall be fitted with inboard screens of sufficient height and so set as to prevent these lights from being seen across the bow and shall be of not less than the following dimensions on motor-boats of:

Class Two.—Eighteen inches long.

Class Three.—Twenty-four inches long: Provided, That motor boats as defined in this Act, when propelled by sail and machinery or under sail alone, shall carry the colored lights suitably screened but not the white lights prescribed by this section.

SEC. 4. (*a*) Every motor boat under the provisions of this Act shall be provided with a whistle or other sound-producing mechanical appliance capable of producing a blast of two seconds or more in duration, and in the case of such boats so provided a blast of at least two seconds shall be deemed a prolonged blast within the meaning of the law.

(*b*) Every motor boat of classes two or three shall carry an efficient foghorn.

(*c*) Every motor boat of classes two or three shall be provided with an efficient bell, which shall be not less than eight inches across the mouth on board of vessels of class three.

SEC. 5. That every motor boat subject to the provisions of this Act, and also all vessels propelled by machinery other than by steam more than sixty-five feet in

length, shall carry either life-preservers or life-belts, or buoyant cushions, or ring buoys, or other device, to be prescribed by the Secretary of Commerce, sufficient to sustain afloat every person on board and so placed as to be readily accessible. All motor boats carrying passengers for hire shall carry one life-preserver of the sort prescribed by the regulations of the board of supervising inspectors for every passenger carried, and no such boat while so carrying passengers for hire shall be operated or navigated except in charge of a person duly licensed for such service by the local board of inspectors. No examination shall be required as the condition of obtaining such a license, and any such license shall be revoked or suspended by the local board of inspectors for misconduct, gross negligence, recklessness in navigation, intemperance, or violation of law on the part of the holder, and if revoked the person holding such license shall be incapable of obtaining another such license for one year from the date of revocation: *Provided,* That motor boats shall not be required to carry licensed officers, except as required by this Act.

SEC. 6. That every motor boat and also every vessel propelled by machinery other than steam, more than sixty-five feet in length, shall carry ready for immediate use the means of promptly and effectually extinguishing burning gasoline.

SEC. 7. That a fine not exceeding one hundred dollars may be imposed for any violation of this Act. The motor boat shall be liable for the said penalty and may be seized and proceeded against, by way of libel, in the district court of the United States for any district within which such vessel may be found.

SEC. 8. That the Secretary of Commerce shall make such regulations as may be necessary to secure the proper execution of this Act by collectors of customs and other officers of the government. And the Secretary of the Department of Commerce may, upon application therefor, remit or mitigate any fine, penalty, or forfeiture relating to

motor boats, except for failure to observe the provision of section six of this Act.

SEC. 9. That all laws and parts of laws only in so far as they are in conflict herewith are hereby repealed: *Provided,* That nothing in this Act shall be deemed to alter or amend Acts of Congress embodying or revising international rules for preventing collisions at sea.

SEC. 10. That this Act shall take effect on and after thirty days after its approval.

Approved June 9, 1910.

ACT OF SEPTEMBER 4, 1890, IN REGARD TO COLLISION AT SEA, THAT WENT INTO EFFECT DECEMBER 15, 1890

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

A PROCLAMATION

Whereas an Act of Congress in regard to collisions at sea was approved September 4, 1890, the said Act being in the following words:

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in every case of collision at sea between two vessels it shall be the duty of the master or person in charge of each vessel, if and so far as he can do so without serious danger to his own vessel, crew, and passengers (if any), to stay by the other vessel until he has ascertained that she has no need of further assistance, and to render to the other vessel, her master, crew, and passengers (if any), such assistance as may be practicable and as may be necessary in order to save them from any danger caused by the collision, and also give to the master or person in charge of the other vessel the name of his own vessel and her port of registry, or the port or place to which she belongs, and also the name of the ports and places from which and to which she is bound. If he fails so to do, and no reasonable cause for such failure is shown, the collision shall, in the absence of proof to the contrary, be deemed to have been caused by his wrongful act, neglect, or default."

CHAPTER XXVIII

NAVIGATION

It is quite impossible in a single chapter to give more than a general idea of the art of navigation. An attempt will be made to describe only the salient points and leave the reader to follow up the explanations and details to be found in any modern book on navigation.

Much of the art of navigation has been reduced to a science, and science requires accurate instruments for the purpose of collecting data to be used in mathematical calculations.

Instruments used in navigation include the following: compass, chronometer, sextant, log, lead, parallel rulers, dividers, barometer. Every navigator should be supplied with a good pair of day glasses and a pair of night binoculars. Charts of the vicinity are of course essential. The above is not the complete outfit provided a modern man-of-war; it is the lowest minimum for navigation. Persevering practice is required to make one expert in the use of nautical instruments.

The navigator uses the nautical mile as the unit of distance. The geographical mile is the length of a minute of arc of the earth's equator. It is 6087.2 feet. The *nautical* mile is the length of a minute of arc of the earth's meridional circumference. The nautical or sea mile varies in length with the latitude. At the equator it is 6046 feet, increasing to 6109 feet at the poles. This is of no importance to the navigator who uses the "mean," or 6076.8 feet. Knot is a unit of speed and not a unit of distance. A speed of 10 knots means that in one hour the vessel referred to will travel a distance of 10 nautical miles.

The compass ranks first in importance in navigation; *without it the ship* is helpless to intelligently direct its

course over the trackless ocean. Mounted in an iron ship, a magnetic compass must be compensated before its usefulness can be realized. Compensation is accomplished by the use of magnets placed in such manner as to oppose accurately the magnetic influences of the ship upon the compass needle. In modern times the gyro-compass is fast taking the place of the magnetic compass. The gyro-compass is explained in a section following.

The compass is divided into points for reference. A point is equal to 11 1-4 degrees of arc, and thus the circle is composed of 32 points. Modern compasses are marked in degrees from 0 degrees to 360 degrees.

The chronometer is merely a very accurate instrument for keeping time. It usually keeps the time of the meridian of Greenwich, which is zero meridian of longitude.

The sextant is an instrument primarily used to measure the angular height of a heavenly body. It can be used also for measuring horizontally the angle between any two objects on the earth's surface; the latter use is particularly valuable in "coasting."

The log is an instrument to measure the speed of the ship through the water. Many varieties of logs exist; the one most commonly used is the Patent Log, composed of a rotating screw or propeller on the end of a long log line connected to an instrument for recording its revolutions. The rotating screw is a piece of metal with adjustable vanes.

The lead is for the purpose of determining the depth of water and character of the bottom. The Sir William Thompson (now Lord Kelvin) sounding machine is the one most frequently employed.

Parallel rulers are used to transfer a direction or course from the compass "rose" on the chart to the position occupied by the ship or vice versa, or for finding graphically the direction of any line on the chart. It is an instrument in common use, both afloat and ashore.

Dividers *are instruments* for measuring distances on *a chart.*

The barometer is an instrument for measuring the weight of the superincumbent atmosphere. It is the surest indicator of bad weather.

In addition to the above instruments, others are required; one of importance is an azimuth circle to fit on the compass for the purpose of taking compass bearings of objects on shore and for observing the compass bearing of the sun in order to find the compass error. The compass error consists of two parts: the variation and the deviation. The variation is the angular distance at that point between true North and magnetic North; this is always given on the chart in curves. The deviation is the angular distance between the magnetic North and the North point of the compass needle and is caused by magnetic disturbances local in the ship and uncorrected by magnets.

The three-arm protractor is a most valuable instrument for coasting. It can be used only when in sight of an accurately surveyed and charted coast. It consists of a graduated circle of brass with one fixed and two movable arms radiating from its centre. To plot the ship's position, select three objects ashore which are laid down on the chart, lighthouses or beacons, church steeples, water tanks, etc. Measure simultaneously the horizontal angles between them (using a sextant). Then on the protractor lay off the angles, first the angle between the left hand object and the middle object with the left leg and the angle between the middle and the right-hand object with the right leg of the protractor. Now place the arms on their respective objects on the chart and move protractor about until the straight edges of arms pass accurately through the objects; then the ship is at the centre of the protractor and this point can be pricked on the chart.

Protractors made of celluloid are now furnished, which are much handier and less expensive.

Dead Reckoning.—When no landmarks can be seen and where the water is too deep for soundings, when the

sky is overcast, then dead reckoning must be used. This reckoning can make no accurate allowance for current or leeway; yet it must be used in default of a more accurate method of obtaining the ship's position. Dead reckoning is also resorted to in a fog, even when coasting. Its accuracy then, however, can be checked by periodic soundings. Chart dead reckoning consists merely in laying off on the chart from a known position or "departure" a line representing the ship's course, and measuring along this line the distance run given either by the patent log or from counting the revolutions of the engines.

In approaching land from sea, having run by dead reckoning, at night or in a fog, all navigators avail themselves of the use of the sounding machine. When the charts show progressive depths, the beginning of reasonable depths (say 50 fathoms), at some distance off shore; now by sounding each half hour, depending, however, upon the speed, and plotting these soundings accurately on a piece of tracing cloth, with the distance run by ship between soundings carefully laid down; then by moving this line of soundings along parallel to the ship's course an accurate estimate can be made as to the ship's position. A change of course through a considerable angle will frequently check this method of position plotting.

Tides and Current.—Tides are caused by the joint attraction of both sun and moon. The moon's attraction is the greater. The highest and lowest tides occur when the moon is full or new and the smallest range when the moon is in its quarter. The swiftest currents are consequent upon the greatest range of tide. In navigating where there is a great range of tide especial care must be observed in frequently "fixing" the ship's position.

The Weather.—The surest indication of the weather is the recorded readings of the barometer. There exist what are known as barometric tides; that is, the barometric pressure fluctuates daily but regularly, being a maximum at 10 A.M. and 10 P.M. and a minimum at 4 P.M. and 4 A.M. *This is most* especially marked in the tropics. If this

diurnal fluctuation is disturbed it is a sure sign of bad weather. The barometer should be read and recorded each hour and frequently referred to. As a general rule, especially in northern latitudes of the vicinity of New York, when the barometer is high, that is much above the normal—30.00 inches, a southerly wind may be expected. If the barometer has been falling gradually each day and is below the normal then a northerly wind may be expected.

Storms are caused by great wind swirls and are of two kinds, cyclonic and anti-cyclonic. The cyclonic swirl has at its centre a low barometric pressure air currents ascending and the swirl in the Northern Hemisphere is counter clockwise. The anti-cyclone swirl has a high barometric pressure air currents descending at its centre and in the Northern Hemisphere the swirl is clockwise. The cyclone is accompanied by much cloudiness and rain, whilst the anticyclone brings dry clear weather.

Fog.—Air of a certain temperature is capable of taking up a certain amount of moisture and of retaining it suspended in a perfectly invisible gaseous state. The higher the temperature of the air the greater its capacity for the retention of water in this invisible form.

Fogs are produced when a hot wind laden with moisture comes in contact with cold water. The hot saturated air becomes chilled, water is condensed and fog formed. This is what occurs off the New England coast in the spring and early summer; the warm saturated air from the Gulf Stream blowing across the relatively cold water off the New England coast produces fog. Any wind from the east to south usually will bring fog in that region.

Fog also will occur when a cold wind blows across the water. In this case the cold air is warmed and it is then capable of taking up more moisture, but at the same time the invisible vapor rising from the water is chilled and is precipitated into fog.

***Deep Sea* Navigation.**—When out of sight of land, *the ship's position* must be fixed by observation of heav-

enly bodies. Without going into the mathematical and astronomical theory of the methods employed, an attempt will be made to describe what sailors term a " day's work " in navigation.

Beginning at noon, the ship's position, latitude and longitude having been accurately obtained, the course is laid on the chart from this position. About 3 P.M. the navigator, with sextant and watch, observes the altitude of the sun, reading his watch time at the moment of the observation. Now, having compared his watch with the ship's chronometer and knowing the corrections of the chronometer, he finds the Greenwich time of his sight.

After working out his sight, using the latitude given by laying off with dividers on the course on the chart the distance run since noon, as shown by patent log or revolutions of the engines, and the time given by the chronometer, he obtains a longitude. However, instead of using one latitude he uses two, say twenty miles apart; this gives in the solutions two longitudes, one for each latitude. Now, if these are both plotted as positions on the chart and a line drawn through them, then the ship is somewhere on that line. This line is a part of a circle of equal altitudes. That is to say, at every point on that line, at the instant the sight was taken, the altitude of the sun was exactly as observed by the navigator.

At sunset, when the horizon is clear, stars are observed in the same way. To learn to recognize stars is one of the important duties of a navigator. These stars give in the same way circles of equal altitudes which plot as straight lines through the two positions obtained.

Now, the 3 P.M. sun line can be brought up by means of the parallel rulers, a distance equal to the run of ship between sights and along the direction steered, and where it cuts the star line will be the position of the ship at sunset. The position at 8 P.M. is gotten by dead reckoning from this fix.

Early in the morning the navigator obtains observation *of stars (sunrise)*, then about 8 A.M. he " shoots" the

sun. At 9 A.M. he may again observe the sun. Lines are plotted for each of these observations, the assumed latitudes being gotten by dead reckoning.

It will be noticed that in all these sights a latitude was assumed and longitude calculated. At sunset and sunrise certain stars may be found near enough to the meridian to permit latitude sights to be used; frequently a navigator is fortunate enough to observe a meridian altitude of a star. Polaris, the North Star, can always be gotten for latitude if it can be seen plainly enough before the horizon becomes obscured.

At noon the sun is observed on the meridian and from this sight the exact latitude at noon is obtained—then, as before, the longitude lines can be brought forward and by a measure of adjustment a fairly accurate position of the ship can be obtained.

Coasting.—This is really the test of a good navigator. A vessel is said to coast when it steers close enough to a shore line to plot itself continuously by taking bearings of charted objects on land.

Every officer should know the height of his eye, when he is on the navigating bridge, from the water. This is important in determining the distance away of objects on shore or to seaward.

When one stands on the bridge of a ship, say height of eye 40 feet above the water, it is convenient to remember the distance of the sea horizon. This distance naturally depends upon the height of the eye and the curvature of the earth's surface; the latter to all intents and purposes is constant. This distance in sea miles happens to correspond approximately to the square root of the height of the eye in feet. The square root of 40 is 6.325. To be more accurate, multiply this by 1.063. The distance then of the sea horizon when at a height of eye of 40 feet is 6.72 sea miles.

Refraction tends to elevate objects, thus a light ashore *due to refraction* may be seen farther than calculations *tend to show.*

Suppose you are coasting at night, and standing on the bridge, height of eye 40 feet; you are expecting to sight the light of a lighthouse on shore. Its height above the sea from the "Light List" is 144 feet. You should see the light "pop" above the horizon when the ship is $1.063 \times (\sqrt{40}$ plus $\sqrt{144}) = 19.58$ miles away. If there is refraction caused by heated air rising from the sand of the beach, the light may appear when the ship is 21.25 miles away, allowing 8 per cent. for refraction.

Methods of getting distance of ship from shore:

(*a*) Cross bearing:

Take compass bearings and obtain true bearing of two charted objects which will cut with a fairly open angle. The ship is at the intersection when plotted on the chart by means of parallel rulers.

(*b*) Three-arm protractor method:

Take simultaneous angles between three charted objects. Plot with protractor; ship is at centre.

(*c*) Twenty-six and a half degree; forty-five degree bearings:

Take a bearing of a fixed object when it bears 26½ degrees from ahead. Take time, read the patent log or the engine revolution counter, or both as a check. Take another bearing when object is 45 degrees from the bow; take time and readings as before. Calculate distance ship has run between the two bearings: this distance is amount ship will be from the object when it bears 90 degrees from ahead, or "abeam."

(*d*) Doubling the angle on the bow:

Take a bearing of a charted object on shore; suppose it bears 30 degrees from ahead. Take time, and reading of patent log or engine revolution counter or both; take similar readings when the angle is doubled, or the object bears 60 degrees from ahead. Then the distance away from the object at the instant of the second bearing, in this case 60 degrees, is equal to the distance the ship has run between the taking of the two bearings.

(*e*) From sextant angles of known heights on shore:

Formula:

$$\text{Distance in Miles} = \frac{\text{Natural cotangent of Angle} \times \text{height of object in feet}}{6080}$$

The distance is to a point vertically under the highest point of the object.

Danger angles can be both vertical and horizontal. Suppose it is desired to steer midway between two islands whose height is known and summits accurately plotted. On the chart measure the distance from a point midway between the two islands, the point to be on the line laid down as the course to be steered by the ship from a position plotted from cross bearings. Call these distances in sea miles *A* and *B*. Then

$$\text{Natural cotangent first angle} = \frac{A}{\frac{\text{Height in feet}}{6080}}$$

$$\text{Natural cotangent second angle} = \frac{B}{\frac{\text{Height in feet}}{6080}}$$

From these formulas find the two angles, call them α and β. Then see that angle (vertical angle of first height), does not increase to more than α and that angle of second height does not increase to more than β. Limits can be allowed in order to keep as near the middle of the channel between the two islands as possible and thus clear outlying shoals or reefs.

Suppose it is desired to steer between two outlying shoals. On the chart two prominent objects are selected on shore. Plot the ship's position accurately by cross-bearings. Lay the course to pass midway between the shoals. Take points on either side of the course at sufficient distance from the shoals for safety. Measure on the chart the horizontal angles subtended by the objects from these two points. Then see that the objects from *the ship do not* subtend an angle greater than the larger *angle or smaller* than the lesser angle. The ship will *then steer* between the two points.

If there is danger only on one side, then describe a circle passing through the two objects and sufficiently far outside of all danger. The angle from any point on the circumference of the circle subtending the two objects is always the same. This may be called a danger angle. As long as the angle subtended by the two objects from the ship is less than this angle the ship is outside of the danger and safe.

Danger Bearing.—From a charted object on shore, draw on the chart a line outside of all charted dangers, reefs, shoals, rocks, etc. Obtain by means of parallel rulers from the compass " rose " on the chart the true bearing or magnetic bearing of this line. This is a danger bearing and the ship must keep the bearing (either true or magnetic) of the object from the ship, as it approaches close to the dangers, always open on the correct side.

For instance, suppose such a bearing of a line drawn from the object, a lighthouse say, is north and south (0° and 180°); zero to the lighthouse and 180 degrees away from it. Suppose the dangers are all within two miles of the light and to the westward of the line. Then, when the ship arrives at a point about five miles from the light it must take frequent bearings of the light and make sure that the lighthouse never bears to the eastward of north.

Wind, Direction and Velocities.—The true direction of the wind at sea from a moving ship cannot be obtained by watching the smoke of the ship or the flags. These give only the apparent direction. That is, the resultant of wind and speed of ship. Note the ripples on the water, or if there is considerable wind, white foam streaks can be seen and their direction determined.

In recording wind velocities, judgment must be depended upon. Experience is probably the best teacher. Young sailors are more apt to underestimate wind velocities than overestimate. It is because they do not like to *acknowledge that* they think the wind is blowing very *strongly.*

The Beaufort Weather Scale.—These are columns in the log book on board ship which must be filled in each hour. Letters are used to indicate the state of the weather; they are:

b. Blue sky.
c. Clouds.
d. Drizzling.
f. Foggy.
g. Gloomy.
h. Hail.
l. Lightning.
m. Misty.
o. Overcast.
p. Passing showers of rain.
q. Squally.
r. Rain.
s. Snow.
t. Thunder.
u. Ugly sky.
v. Very clear atmosphere.
w. Heavy dew.

The Beaufort Wind Scale.—The force and direction of the wind must be logged hourly. This is done by the following scale. It is merely arbitrary notations:

0. Calm.
1. Light airs, wind velocity 7 miles.
2. Light breeze, wind velocity 12 miles.
3. Gentle breeze, wind velocity 16 miles.
4. Moderate breeze, wind velocity 20 miles.
5. Stiff breeze, wind velocity 24 miles.
6. Strong breeze, wind velocity 30 miles.
7. Moderate gale, wind velocity 35 miles.
8. Fresh gale, wind velocity 42 miles.
9. Strong gale, wind velocity 48 miles.
10. Whole gale, wind velocity 56 miles.
11. Storm, wind velocity 65 miles.
12. Hurricane, wind velocity 80 or more miles.

Useful Formulæ and Information.—

Circumference of a circle $= 2\pi r$
Area of a circle $= \pi r^2$
Area surface of sphere $= 4\pi r^2$
Volume of a sphere $= \pi r^3$
Area surface of cone $= \pi r l$
Volume of cone $= \pi r^2 h$

Sine 60° $= \frac{\sqrt{3}}{2}$ Sine 30° = cosine 60° = ½

Sine 45° $= \frac{1}{\sqrt{2}}$ $\pi = 3.1416$. $\sqrt{3} = 1.732$

$\sqrt{2} = 1.414$.

1 cubic foot of fresh water weighs 62.5 pounds.
Sound travels in air 1100 feet per second.
Sound travels in water 4400 feet per second.
Light, radio and all ether vibrations travel at a speed of *186,000 miles* per second.

Star-sights.—Many old-time navigators scoff at star-sights, claiming them to be misleading and inaccurate. Now there is no doubt of the accuracy of a star-sight if the horizon is good. Therefore, if the star-sight is taken either at sunrise or sunset, there is no reason why the sight will not be perfectly accurate.

All who must navigate, either for duty or pleasure, should know how to locate the stars or at least a fair proportion of the brightest of them. Stars are most difficult to distinguish one from another when the sky is partly overcast, but when the sky is clear there should be no difficulty whatsoever if one has learned their position in relation to well-known constellations.

Sighting a Light.—Modern high-power lights (light-houses or lightships) can frequently be discovered by their light beam in the sky before the light itself lifts above the horizon. To be sure, use your night glasses. If there are no glasses at hand, turn your head away and glance at the supposed light from out the corner of your eye. If you still see it, the light is there.

Warning of Dangers.—You can frequently smell the land, which should warn you of its proximity. In the vicinity of icebergs, a streak of cold air should be a warning that a berg is to windward. Floating seaweed or the smell of seaweed warns that rocks may not be far distant. In shoal water the wave following a ship will be noticeably increased in size to what it had been in deep water.

In a fog or at night the echo from the whistle may give valuable information as to nearness of icebergs or high land. When in close waters fix the position of the ship on the chart constantly. It is wise to have this done by an assistant, for the navigator must keep his eyes open and not bury himself in his chart board.

Buoys.—In coming from seaward, *red* buoys mark the starboard or *right*-hand side of the channel, and black *buoys the port or left* side.

Dangers and obstructions which may be passed on

either side are marked by buoys with ***black*** and ***red horizontal*** stripes and may be left on either hand.

Buoys indicating the fairway are marked with ***black*** and *white* vertical stripes and should be passed close to.

Sunken wrecks are marked by the red and black obstruction buoys described above. In foreign countries green buoys are frequently used to mark sunken wrecks.

Quarantine buoys are yellow.

As white buoys have no special significance they are frequently used for special purposes not connected with navigation.

The starboard and port buoys are numbered from the seaward end of the channel, the *black* bearing the *odd* and the *red* the *even* numbers.

Perches with balls, cages, etc., will, when placed on buoys, be at turning points, the color and number indicating on which side they shall be passed.

Buoys are of several kinds and float, being anchored securely in position. *Spar* buoys are placed where the water is usually smooth and therefore such a buoy can be readily seen. *Nun* buoys, steel cylinders with conical tops, are used in disturbed waters to mark the starboard side of channels and obstructions, and mid-channel. *Can* buoys, which are flat top steel cylinders, are similarly used and mark the port side of channels and obstructions, and mid-channel. *Gas* buoys, *bell* buoys, *whistling* buoys and combination *gas* and *whistling* buoys are used in their several capacities to mark channels and are appropriately colored or marked for identification.

A spindle, usually consisting of an iron shaft surmounted by a cask, or some other shape, is placed on a submerged rock or shoal and appropriately colored.

Beacons are built of stone on shoals or prominent landmarks. They are surmounted by a spindle and colored; sometimes they are lighted.

Before entering a harbor first study the buoys on the *chart; obtain* their numbers, and in passing each buoy *make a check* alongside of it in order to avoid confusion.

The Gyroscope Compass.—The magnetic compass, influenced by the magnetic field of the earth acting as a great magnet, points to the magnetic north. When such a compass is mounted on board an iron or steel ship, there is introduced a secondary magnetic field caused by the fact that the steel ship is also a magnet. The needle of the magnetic compass, therefore, points in a direction which is the resultant of the two magnetic fields. When a magnetic compass is mounted in the interior of a steel shell, this resultant field is composed principally of ship's magnetism; the earth's magnetism then has but slight effect. Therefore the compass is practically useless for ascertaining the magnetic north.

The gyroscopic compass is in no way affected by magnetism and has been manufactured for use where the magnetic compass is valueless. In the U. S. Navy gyroscopic compasses or "gyro" compasses are installed in all important ships. The magnetic compass is used in addition as a secondary compass, and it is mounted on deck well above the influences of large masses of steel, where the effect of the ship's magnetism will be a minimum.

The gyroscope is an instrument which renders available the unused physical directive force of the earth's rotation, and gives us a compass that points true geographical north while in a stationary position. It is absolutely unaffected by magnetism. The main difference then between the magnetic compass and the gyroscopic compass is that while the former utilizes the directive force of the earth's magnetism in pointing to magnetic north, the latter utilizes the physical directive force of the earth's rotation in pointing to true or geographical north.

The principle upon which the gyroscopic compass depends for its operation may be stated as follows: Any revolving mass, such as a spinning wheel, tends to swing *around so as to bring* its axis of rotation parallel to the *axis of any* externally applied (angular) force and in

such manner that the direction of its rotation will be the same as the direction of the applied force.

A rapidly spinning gyroscope depends for its directive force factor solely upon the forces that reach it; on land or in a locality fixed with respect to the earth, as, for instance, upon a ship at anchor, it will be affected by the forces due to the earth's rotation. Therefore, the spinning wheel, under the earth's applied force, will tend to swing around so as to bring its axis of rotation parallel to the axis of the earth and its direction of rotation will be the same as that of the earth.

However, when the gyroscopic compass is mounted on a ship in motion, with a northerly or southerly component, the gyroscope will no longer receive simple easterly motion from the earth's rotation but a mixed motion, and the axis is accordingly deflected from the meridian or true north line. The amount of this deflection depends upon the course and speed of the ship and upon the latitude. By means of automatic correcting devices this deflection is exactly compensated, so that all readings of the master compass are accurate continuously.

The "gyro" outfit for a battleship and submarine boat is composed of a master compass, 90-volt, three-phase alternating-current motor generator, 24-volt direct-current dynamotor, 40-ampère-hour storage battery, 6-volt dry-cell battery, switchboard, and three to seven-repeater compasses.

The gyro wheel is of high grade special steel, perfectly balanced. It is driven by means of an inbuilt squirrel cage induction motor, the external rotor of which forms part of the wheel, which is mounted in a case in ball-bearings and revolves in a vacuum at approximately 8600 revolutions per minute. The wheel is finished smoothly to reduce wind friction to a minimum, and carries a sighting spiral by means of which the speed of rotation is determined. The three-phase motor, which is designed to stand a large overload, is also mounted inside the gyro casing.

After the master compass and its equipment have been assembled, it is given a test occupying a week's time, during which every characteristic of each part is carefully examined under extraordinarily severe conditions artificially reproduced for the purpose.

The reason for the great precision of the gyro compass over the magnetic compass can be understood readily enough when we consider that the physical directive force of the earth's rotation upon the gyro compass is 291 times the directive force induced by the earth's magnetism upon a 7½-inch navy compass.

To operate the repeater compasses, a secondary transmission system is employed. This consists of a transmitter operated by and forming part of the master compass. Various forms of repeaters operated by the transmitter are located at distant points of the ship. In appearance they resemble ordinary compass cards and point true north. The transmitter is power driven and connected with the automatic correction devices so that all readings are correct and repeaters bear in the true meridian irrespective of the movement of the ship. Repeating instruments are positively driven by step-by-step motors. These instruments follow the movements of the master compass with a maximum error of about one-twelfth of a degree and a lag of about one one-hundredth of an inch.

The compass has incorporated in it means for preventing oscillation and for artificial orientation coupled with a device independent of the compass card. This consists of a very sensitive level mounted on the east side of the gyro casing which at all times when the gyro wheel is spinning indicates when the compass is exactly in the meridian, and when the compass is not in the meridian will indicate the direction toward which the meridian may be found and also the approximate number of degrees the compass is away from the meridian. When starting up the gyro, it is possible by this means to find the meridian in a *very few minutes* when no means of knowing its *direction exists*. This important facility avoids delays in

waiting for the normal settling of the compass card in the meridian.

Inasmuch as the gyro compass is not affected by magnetism it can be placed in securely protected positions behind armor and below armored decks and courses can be steered by means of the repeaters from any selected position in the ship.

Repeaters are installed also in pelorus stands in place of the " dumb " compasses, enabling bearings to be taken quickly and accurately.

Navigating Motor Boats in Fogs.—The value of using one's wits or his common sense holds at sea even more than on land. Fog is to many, especially the landsman, a very much dreaded thing. When once enveloped in a fog, all sense of direction vanishes; if the compass should be unreliable then the vessel is indeed helpless. But is this so, provided one uses his wits and trusts to common sense to guide him to his destination?

To exemplify how wits can be used in a fog where everything else has failed, the following actual cases have been given me by Mr. George S. Goldie, whose " Novice to Pilot " should be in the pilot-house of every motor boat.

CASE I.—Our party was proceeding along a river just before midnight when suddenly we were enveloped in a dense fog. There was no compass on board. One of the party having a good sense of direction had noted that what little air there was had been coming from about four points on the starboard bow. A light held over the side failed to disclose a single ripple, for the glare made the water appear flat. By putting out or shading all lights on the boat, the ripples were brought into relief, and by their aid the boat was navigated safely home.

CASE II.—Our launch left New London in a dense fog to go to an island that lay about 15 miles to the south of us. On the outside of this island the ocean rolls unimpeded; on the inner side there lies a bay many miles in extent. The start was made in fog and we located ourselves three times on the way.

From the last of these departures to our destination was a distance of several miles, but across water having a strong current when the tide is in motion. Our course was laid to leave the northern point of the island on our port hand. Our calculations were that the tide would be at the slack, therefore we made no allowance for current and headed straight on the compass bearing for the point. When we had covered the distance by the watch, no point was in sight. The depths in that region being nearly level and the bottom of white sand, soundings were useless. However, the finding of our position was simple enough. If we had missed the point and passed it in the fog on our port hand, then we would have found ourselves in smooth water, or, if the ocean swell was noticeable it would be coming to us from astern, as it curved around the point. We were, on the contrary, in a distinct swell, and therefore judged ourselves to be on the outside of the island. We swung the boat sharply to starboard and picked up the point at once.

CASE III.—An illustration of the use of disturbed water as a guide to direction is contained in the following: During one of those fogs that cause moisture to collect on the hair or on the clothing, we left the sheltering arms of a small sound and headed for an island lying fourteen miles distant in the ocean. The island lay with its six miles of length directly across our path. Scarcely had we left smooth water when a violent sea swell running on our port bow caused our card compass to revolve. Touching the compass with the finger to make it oscillate so we might use the half of the swing was of no avail; the compass made complete circles immediately upon being released. We, therefore, kept the swell and also the slight wind ripples bearing in the same direction as when first we laid our course. After a time the sea swell on our port bow began to diminish because of a swell which grew perceptibly on our starboard bow. Presently nothing but the starboard swell was in evidence; finally that died out and we were running in flat water and our com-

pass again was working properly. In a short time the boat was brought to a standstill for a sounding. When the noise of the motor ceased the boom of beach breakers was heard. Without taking the sounding, the boat was started ahead and we soon sighted the island and the entrance to the harbor.

The reasons for this method of navigation may be simply told. We knew that the ocean swell was striking the sea side of the island at an angle to the left of our course. Therefore the sea swell in sweeping around the end of the island on our port hand would have less angle to turn than around the end of the island on our starboard hand and consequently we would get the swell first on our port bow. Then as we got nearer the island the swell coming around the end on our starboard hand was felt. Gradually all swell died away and we knew we were in the lee of the island.

The cause of the swell being felt as described lies in the fact that the shore end of a wave is retarded and the other end bends around toward the shore as it advances. The sound of the breakers came from the surf beating on the sea end of the island, and from local knowledge it was known that the sound was coming over a low sand ridge near the harbor itself.

Case IV.—On another occasion our boat left the shelter of a breakwater. One of the party was strongly opposed to making a run of 35 miles through the blanket fog which prevailed. Finally after all accurate knowledge of our position had been lost it was decided that we proceed. A course was set that we hoped would enable us to pick up a bell-buoy, over two miles away, from which our course for a 21-mile run was to be made. When about a mile had been covered the practiced eye of one of our party discerned a large spot in the water of a lighter shade than the water surrounding it; he knew that the change of color was caused by a ten-feet shoal, and the chart showed that the line from the shoal to the buoy was the same as our course. However, we did not find

the buoy. When the time by the watch was run out, the motor was stopped and a sounding taken. Very fine sand mixed with black and red specks was brought up on the arming. This told us that because the sea was so smooth, the bell was not ringing and that it was within a stone's throw of us. We knew this because sand of that description is found nowhere else in that vicinity. The boat was started with confidence on the next course, and it was made good.

CASE V.—On one occasion we had been running all day in a 36-mile breeze from the southwest. As we entered the Nantucket Shoals from the eastward, night shut in and with it an increase of the breeze and more fog. Before the Stone Horse Shoal was reached the sea had battered out our bow light, the starboard and port lights and the compass light. The night was very black and the seas repeatedly washed us from stem to stern. We managed to make the 15 miles or more to the Cross Rip light vessel and smooth water without the compass. The manner of the navigation will seem simple when explained. It was reasoned that a breeze of nearly 40 miles an hour would be fairly steady in direction and, though the motion of the boat could not be seen, it could be felt. When the attempt to light the compass was given up, the compass course of the boat relative to the direction of the sea was noted and the boat's behavior. Then by comparison, if the boat rolled too much for that course she was headed into the seas a trifle, if she pitched too heavily she was kept off a trifle.

CHAPTER XXIX

NAVAL CONSTRUCTION

EVERY officer and man in the navy should acquire some knowledge of the science of Naval Construction. It is not required that he must be a skilled naval architect; long years of study and practical work in designing and building warships is the one means to that goal; but one should be able to discuss intelligently the construction of the ship on board of which he is serving and be capable of reading and understanding the many drawings of his ship furnished by the builders.

The lines of the ship are shown on the sheer draft. This is a line drawing of a ship's form and includes: The Sheer Plan, the Half Breadth Plan, and the Body Plan.

The Sheer Plan is a side view of the boundary lines of a ship; the keel, contour of stem and stern, the rail and deck lines at the side, the water lines, the bow and buttock lines and the diagonal lines and cross-section stations.

The Half Breadth Plan is the horizontal plan of one side of the ship (both sides are necessarily symmetrical); in this plan are lines showing the forms of the various water lines, rail and deck lines at the side, the cross-section stations, and the bow and buttock lines and development of diagonals.

The Body Plan consists of a pair of half transverse elevations or end views of the ship, both having the same middle line, so that the right-hand side represents the ship as seen from ahead, and the left-hand side as seen from astern. On the body plan appear the forms of the various cross-sections, the curvature of the rail and deck lines at the side, the water lines, bow and buttock lines, and the diagonal lines.

Water lines, deck lines, bow and buttock lines, diagonal lines shown in the plans of a ship delineate the outside *form of the ship.*

The profile and plans give all the internal arrangements of the vessel, the hold or spaces set aside for storerooms, magazines, shell rooms, etc., the berthing space, the position of engines and boilers, coal bunkers, oil tanks, etc., and the distribution of armor and armament.

The Sheer of a ship is the curve of the rail, decks, etc., from amidship to bow and stern.

Sheer Lines show the amount of sheer, determine the head of frames and mark the height of the deck beams at side.

In this country the *base line* from which all vertical dimensions and heights are measured is a line coincident with the bottom of the keel.

The Forward Perpendicular is a line perpendicular to the keel line and intersecting the forward side of the stem at the designed load water line.

After Perpendicular is a line perpendicular to the keel line tangent to the after-contour of stem.

The Length between Perpendiculars is the distance between the two perpendiculars.

Length Over All is the length measured from a line perpendicular to the base line and tangent to the forward side of the stem to a line perpendicular to the base line and tangent to the after-end of the stern.

Moulded Breadth is the width of the widest frame at its outside.

Depth Moulded is the depth from the top of the keel to the top of the main deck beam at side.

Draft is the depth from water line to bottom of keel when a vessel is afloat.

Mean Draft is the average between that measured at bow and at stern, or that measured at middle of length.

Load Draft is the draft at load displacement.

Trim is the difference of draft at bow from that at stern.

Drag is the designed excess of draft aft over that *forward.*

Draft Marks are numerals indicating the draft at bow

and stern. The numbers are usually six inches high, the even foot indicated being at the bottom of the mark.

Displacement is the amount of water displaced by the ship when floating. It is expressed in tons at 35 cubic feet to the ton of sea water.

Centre of Buoyancy. The centre of gravity of the immersed volume of the displacement; the point through which the force of buoyancy acts.

Centre of Gravity is the resultant point at which the weight of the ship may be considered to be concentrated.

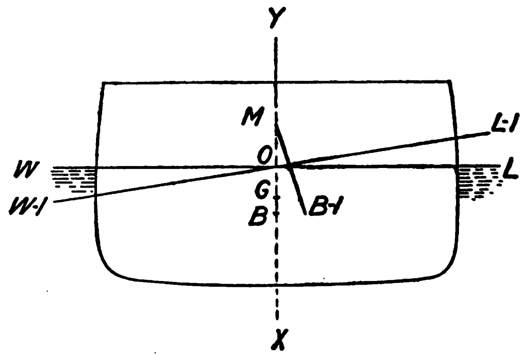


FIG. 20.

Centre of Flotation is the centre of gravity of the load water plane of a ship.

Metacentre. If a ship is inclined to a small angle and a perpendicular be drawn to the load water-plane in the inclined position W-1, L-1, through the centre of buoyancy in the inclined position, B-1, this perpendicular will intersect in some point a similar perpendicular drawn through the centre of buoyancy in the upright position B to the load water plane in the upright position W-L; the point of intersection M is the *metacentre*.

Block Coefficient is the ratio which the immersed *volume of ship* bears to the circumscribing rectangular *solid*.

Coefficient of Fineness of midship section and of water-plane is the ratio which the area of midship section (below L. W. L.) and area of water-plane bears to the circumscribing rectangle.

After the plans of a ship are made the areas must be accurately calculated. These are usually calculated either by Simpson's rules or by the trapezoidal rule. The full details of this calculation are made on special ruled forms for compactness and ready recording.

The following well-known curves among others are obtained and plotted: (*a*) displacement curves (points are obtained for consecutive drafts); (*b*) curve of tons per inch immersion (this curve represents at various drafts the tons of displacement per inch of depth of hull at that draft); (*c*) curves of areas of midship section.

The following are among the many calculations that are made: (*a*) Calculations of moments of areas and centres of gravity of areas; (*b*) calculations of position of centre of buoyancy both fore and aft and transverse.

Equilibrium.—A ship floating in water and at rest will displace a volume of water equal to its weight. The downward force of the weight of the vessel is supposed concentrated at the centre of gravity. The upward force of buoyancy acts up through centre of buoyancy. The centre of gravity and centre of buoyancy are in same vertical line, otherwise a couple would exist tending toward rotation.

A vessel is said to be in stable-equilibrium when, if she is inclined from her position of rest, she tends to return to it; and in unstable-equilibrium if she tends to go farther away from it.

In Fig. 21 a transverse section of a ship is shown inclined at a small angle by some external force.

The volume of displacement has not changed. The centre of gravity remains in the same position. As the shape of the immersed volume has changed the centre of *buoyancy has* moved.

Buoyancy acts up through B-1, gravity acts down

through G. The moment tending to right the ship, to bring her upright, is W x GZ, W being weight of ship. G Z is perpendicular to B-1 M.

The distance G M is the metacentric height and its height is a direct measure of the vessel's stability. The "inclining experiment" is to determine the vertical location of the centre of gravity of the vessel; knowing that, the height G. M. is obtained from the plans of the vessel.

There are a number of terms used in defining the conditions of stability of ships which will be quickly reviewed:

Curve of Static Stability shows the righting lever for each degree of inclination of the vessel.

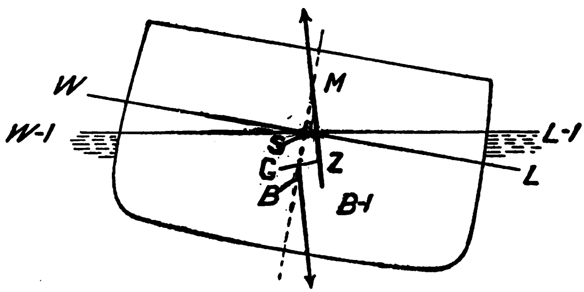


FIG. 21.

Maximum Righting Arm. At a definite number of degrees of inclination the righting moment is at a maximum.

Range of Stability, the number of degrees a vessel may be inclined and yet tend to return to the upright.

Vanishing Stability. The point on the curve of static stability where righting moment is zero.

Period of Oscillation, the time a ship will take to make one complete oscillation, irrespective of the amount of roll.

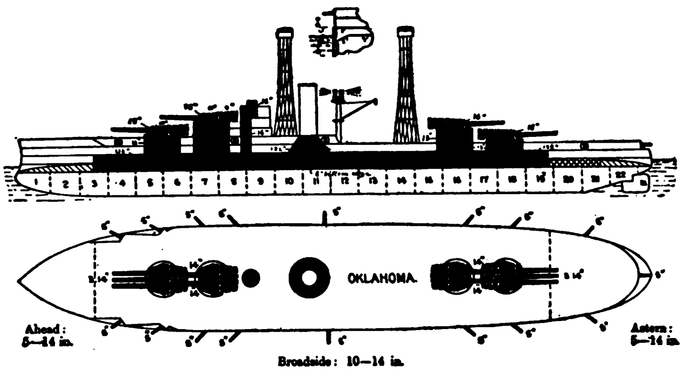
A vessel with a large metacentric height will have a shorter period of oscillation than one with short metacentric height, therefore the better gun platform will be the latter, but such a vessel will be less stable. Battle-

ships have long period of oscillation, destroyers and small cruisers have short periods of oscillation.

Bilge Keels are fitted upon vessels to quench rolling.

CLASSIFICATION OF SHIPS

Battleships.—These vessels form the first line of battle—heavily gunned and armored—moderate speed—large displacement.



From "Jane's Fighting Ships".

FIG. 22.

The sketch shows the United States Battleship " Oklahoma "—displacement 28,400 tons.

Battery: 10 14-inch 45-calibre guns;
21 5-inch 51-calibre guns;
4 21-inch submerged torpedo tubes.

Armor: Belt, amidships, 13½ inches; at bottom edge, 8 inches;
Base of funnel, 13½ inches;
Turret bases, 13 inches;
Turret, front, 18–16 inches;
Turret, side, 10 inches;
Turret, back, 9 inches;
Armored deck, 3 inches;
Conning tower, 16 inches.

Horsepower, 24,800; speed, 20.5 knots.

Fuel capacity, 2000 tons oil.

Cruisers.—Fast—heavily gunned—moderately armored—large displacement.

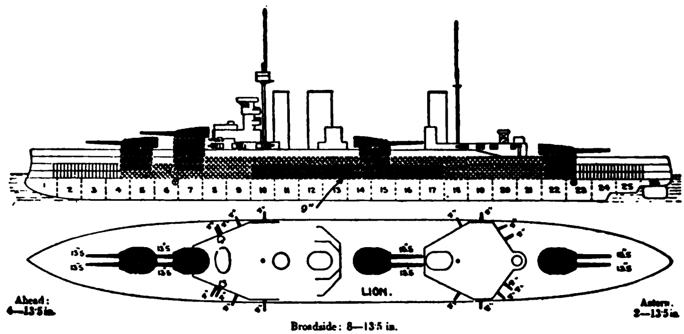


FIG. 23.

The sketch shows the British Battle Cruiser "Lion," displacement 30,400 tons.

Battery: 8 13.5-inch, 45-calibre guns;
16 4 -inch, 50-calibre guns;
3 21 -inch submerged torpedo tubes.

Armor: Belt, amidships, 9 inches;
Belt, ends, 4 inches;
Turret bases, 9 inches;
Turrets, 10 inches;
Armored deck, 3 inches.

Horsepower, 41,000; speed, 25 knots.
Fuel capacity, 3000 tons of coal.

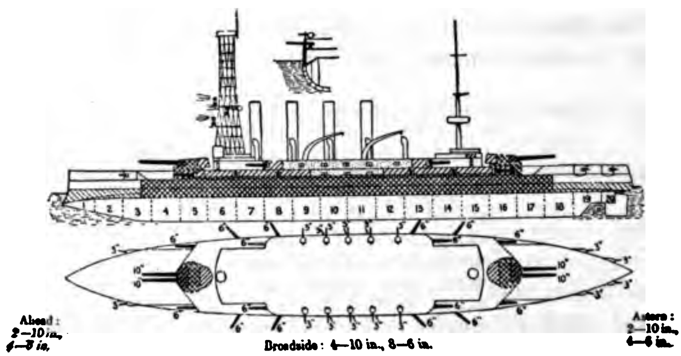


FIG. 24.

The sketch shows the United States Armored Cruiser "North Carolina," displacement 14,500 tons.

Battery: 4 10-inch, 40-calibre guns;
16 6-inch, 50-calibre guns;
24 3-inch, 50-calibre guns;
4 21-inch submerged torpedo tubes.
Armor: Belt, 5–3 inches;
Gun protection, 5–2 inches
Turret bases, 7 inches;
Turrets, 9–5 inches;
Conning tower, 9 inches;
Armored deck, 3 inches.
Horsepower, 23,000; speed, 22 knots.
Fuel capacity, 2100 tons coal.

Scouts.—High speed—light guns and but little armor.

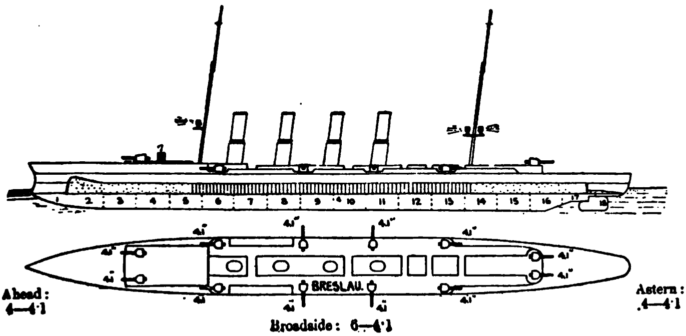


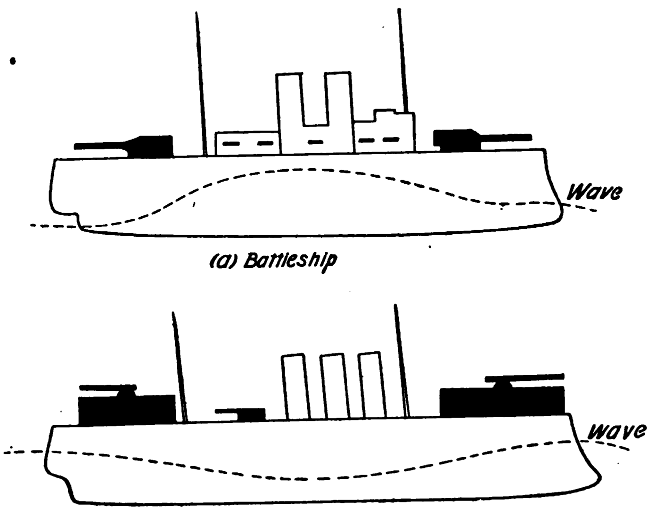
FIG. 25.

The sketch shows the German Scout Cruiser "Breslau." Displacement, 4550 tons.

Battery: 12 4.1-inch, 45-calibre guns;
2 20 -inch submerged torpedo tubes.
Armor: Belt, 3½ inches, ends 2¼ inches;
Deck, 2 inches;
Conning tower, 4 inches.
Horsepower, 22,300; speed, 25½ knots.
Fuel capacity, 1200 tons coal and 130 tons oil.

A warship carries very heavy weights concentrated at *certain locations,* such as armor, turrets, guns, etc., and is *subjected to* certain stresses.

In sketch (*a*) is shown a turret ship such as a battleship or battle-cruiser with a wave crest at the middle of its length. In sketch (*b*) is shown a torpedo craft with the trough of the wave at the middle of its length. For these vessels the above is the most severe condition. If the structure in (*a*) has not sufficient strength, the ends will tend to droop and the effect is called "hogging." If the structure in (*b*) has not sufficient strength the middle



(a) Battleship

(b) Destroyer

FIG. 26.

tends to droop and the effect is called "sagging. Destroyers have been known to break in two from "sagging." Great care is necessary in designing warships to give them sufficient structural strength to prevent either hogging or sagging.

The naval architect prepares the plans of a warship, laying down the lines, and the shipbuilder executes them.

The shipbuilder finds in the plans the shapes of the various pieces of the ship—each piece must be so fashioned as to find its place and fit its neighbors.

The sheer draft, described above, is laid down in true size on the mold loft floor.

A model in wood of the vessel is made usually upon a scale of one-quarter inch to the foot or one-forty-eighth actual size. Upon the model lines are accurately drawn showing positions of frames and edges and butts of shell plating. From the measurements taken from this model material is ordered for the construction of the hull of the ship.

The next process is "laying off"—usually done on a marble slab on one-inch scale.

From "laying off" are determined the forms of the various pieces of the hull construction, so that when put together they will form the frame of the vessel, having the exact form and dimensions intended by the naval architect.

The various methods of bevellings, punching, riveting, etc., will be found in any book on naval architecture.

After constructing a certain proportion of the hull of the ship it is then launched from the building ways and the vessel is further completed in the water. Battleships are usually launched when from 60 to 70 per cent. completed. Destroyers and submarines are frequently kept on the building ways until practically finished.

Docking is placing a ship in a drydock or hauling it out upon a marine railway. This is done periodically to clean the vessel's bottom, grind in sea valves, renew zinc slabs to prevent corrosion in the vicinity of composition metal worked into the structure of steel; for instance, around sea valves and propellers.

A ship's framing consists of vertical keel, longitudinal frames and transverse frames. The stem and stern pieces are usually great castings. By means of frames, angle irons, and plates, the double bottom and all compartments are enclosed. An armored deck or protective is worked in in the same manner as is a deck, but more securely fastened. At the side this deck is fastened to the belt armor.

The following nomenclature of decks is followed for United States naval vessels; this nomenclature does not apply to ships built, or those for which plans were completed on January 1, 1913:

(*a*) The highest deck extending from stem to stern shall be called the "main deck."

(*b*) A partial deck above the main deck at the bow shall be called the "forecastle deck"; at the stern, "poop deck"; amidships, "upper deck."

(*c*) The name "upper deck," instead of "forecastle deck," or "poop deck," shall be applied to a partial deck extending from the waist to either bow or stern.

(*d*) A partial deck above the main, upper, forecastle, or poop deck, and not extending to the side of the ship, shall be called the "superstructure deck."

(*e*) A complete deck below the main deck shall be called the "second deck." Where there are two or more complete decks below the main deck they shall be called the "second deck," "third deck," "fourth deck," etc.

(*f*) A partial deck above the lowest complete deck and below the main deck shall be called the "half deck."

(*g*) A partial deck below the lowest complete deck shall be called the "platform deck." Where there are two or more partial decks below the lowest complete deck the one immediately below the lowest complete deck shall be called the "first platform," the next shall be called the "second platform," and so on.

(*h*) Decks which for protective purposes are fitted with plating of extra strength and thickness shall be further defined, for technical purposes, as "protective" and "splinter" in addition to their regular names. Where there is only one such deck it shall be defined as "protective," and where there are two, that having the thicker plating shall be defined as "protective," and that having the thinner plating shall be defined as "splinter," in addition to the regular names.

(*i*) Where a protective deck is stepped a complete deck height the respective portions shall be distinguished

by means of the terms "middle protective section" and "forward (or after) protective section," in addition to the regular names. Where a splinter deck is stepped a complete deck height, the respective portions shall be similarly distinguished.

(*j*) Where a portion of the protective or splinter deck is sloped, the sloping portion shall be defined as the "inclined protective deck," or "inclined splinter deck."

Ventilation is by both supply and exhaust, using electrically driven fans. Coal bunkers are ventilated through smokestack uptake enclosures. The ventilation piping, drainage system, including the means of pumping out every compartment in the ship, fire main system, and flushing system, are all taken care of by the naval architect and shipbuilder.

The arrangements for coaling or oiling of the ship are designed by the naval architect. He receives frequent suggestions from the operators—the officers and men who man the ship.

Armor, turrets, boat cranes, winches, boat davits, anchor gear, including engine, steering gear, etc., are designed by the naval architect and installed under his direction.

One of the most important features of a warship is the water-tight subdivisions and the system of preserving the water-tight integrity of the vessel in case one or more compartments have been flooded. This is accomplished by a system of water-tight compartments, bounded by water-tight bulkheads and decks. All openings through water-tight bulkheads and decks are themselves water-tight when closed.

In the construction of a ship the naval architect is responsible for the underwater form of the vessel and he must so construct the lines in order that the engines developing a specified horse-power will drive the vessel at the stipulated speed. This is accomplished by trial in the *model tank*. A small model of the vessel is made and *by towing the model* in the tank the resistance is deter-

mined and the lines of the model then may be altered to reduce the resistance to that desired for the horsepower, or vice versa, the horsepower is found to drive the model at a stipulated speed and the engines so designed to develop the required horsepower.

SUBMARINES

The submarine, like all vessels that float, has what is called reserve of buoyancy on the surface. This buoyancy is destroyed by flooding with sea-water so-called ballast tanks. The designer must locate his tanks and arrange their capacities in order that when these tanks are full

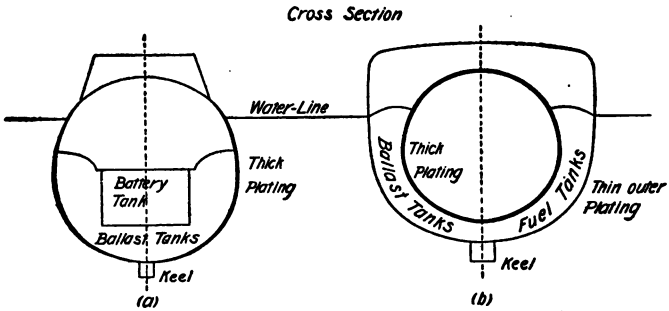


FIG. 27.

of water the submarine will submerge on an even keel and have only a very small percentage of reserve of buoyancy. In order to compensate for movable weights such as food, men, stores, fuel, etc., certain extra ballast tanks are provided. These are trimming tanks and auxiliary or diving tanks. The former are situated, one in bow and one in stern of vessel; the diving tank is near the centre of gravity of the submarine.

All submarines have a pressure hull or spindle. This spindle contains machinery, batteries, motors, torpedoes. and in the case of certain types, all the ballast tanks are within this spindle.

Submarines bui[illegible] simple spindle hull are called

single hull vessels. See sketch (*a*). Those built with an outer hull enclosing the spindle hull are called double-hull vessels, sketch (*b*). The spindle hull is of thick plating designed to withstand a pressure of from 70 to 90 pounds per square inch.

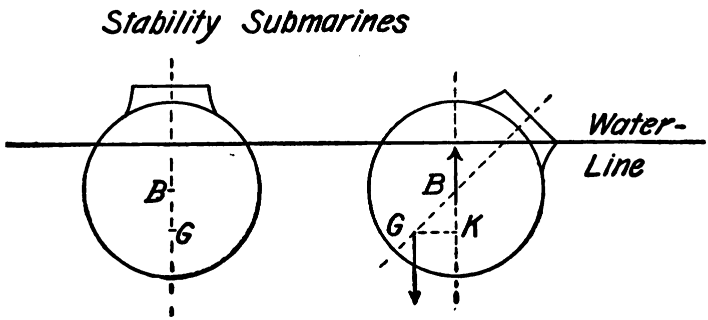


FIG. 28.

The single hull vessels carry everything within the single hull, there being no other available place. The double hull vessels carry both ballast and fuel tanks between the spindle hull and the outer hull.

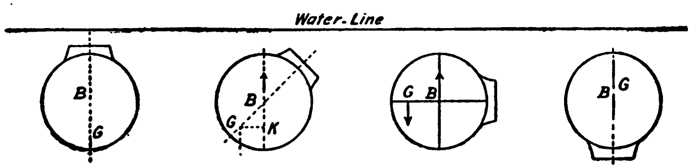


FIG. 29.

The idea of the double hull is to give added reserve of buoyancy in surface condition.

Submarines built for high surface speed are always double hull vessels. For moderate speeds, about 14 to 15 knots as a maximum, the single hull type answers the purpose.

Single Hull Type.—The centre of gravity is invariably below the centre of buoyancy when the vessel is in surface trim, see Fig. 28. If the submarine is transversely inclined, the section being a circle, the shape of the underwater surface does not alter, therefore the centre of buoyancy virtually remains in its position and the centre of gravity moves out from the old vertical plane. Actually the centre of gravity is stationary and the centre of buoyancy moves. The length G. K. measures the stability.

Now when vessel submerges the centre of gravity

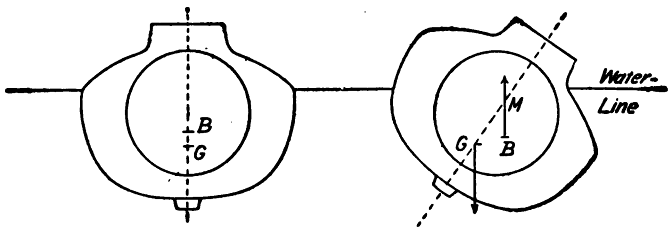


FIG. 30.

actually becomes lower and the centre of buoyancy rises to the geometric centre of the circle (Fig. 29).

Stability is measured by the length G. K. It is a maximum when the submarine is heeled over to an angle of 90 degrees. When at 180 degrees the submarine is exactly in equilibrium; however, if weights do not shift, a single degree change of inclination would cause the vessel to right itself.

Double Hull Type.—On the surface this type is the same as a surface vessel. The centre of gravity is usually below the centre of buoyancy. Of course when totally submerged the C. G. must be below C. B. for stable equilibrium.

The largest value of G. M. (metacentric height) occurs *when vessel is* inclined at a small angle (Fig. 30).

CHAPTER XXX

ORDNANCE

Ordnance applies to the material, such as guns, mounts, ammunition, and the appliances useful to the service of the battery.

Gunnery is the science of the use of the ordnance material.

Calibre, the diameter of the bore of a gun measured at the muzzle.

Bore, the cylindrical hole extending from the rear face of the gun tube to the muzzle face of the gun. It forms the path for the projectile and serves to hold the powder charge before firing and the gas after firing.

Length of gun is expressed in terms of the *calibre.*

Making Naval Guns.—Naval guns are built up of nickel steel. A gun consists of a tube with jacket and hoops shrunk upon it. After the gun is assembled, that is, completely built up, with the last hoop to be shrunk on in place, it is ready to be finished. This finishing consists of: placing the gun in a lathe and (*a*) finish forging, (*b*) finish turning, (*c*) chambering, (*d*) bore-searching and star gauging, (*e*) chasing the thread for screw-box collar, (*f*) rifling.

After this the breech mechanism is fitted and the yoke put on; either shrunk or screwed on the jacket hoop. The gun is now ready for balancing and weighing, and afterwards, inspection.

The *chamber* of a gun is the seat of the powder charge, located between end of rifling and the face of breech plug.

Naval gns are trunnionless; they are fitted to and supported by slides. The slides are trunnioned and rest on knife edges. The position of the gun in the slide is adjusted so that the loaded gun and slide will be a perfect balance, thereby requiring practically no power to elevate and depress the gun.

Rifling, special grooves cut on the surface of the bore

of the gun. The raised portions between the grooves are called the "lands." Rifling gives the projectile rotation about its axis. The gyroscopic force keeps the long axis of the projectile always tangent to the trajectory. The axis of the projectile is always parallel to the direction in which the projectile is moving. A projectile with insufficient rotation will "tumble," that is, will wabble on its axis and be deflected out of its trajectory.

Naval guns use smokeless powder. Our powder is made of ordinary gun-cotton soluble in a mixture of ether and alcohol; it is called nitrocellulose powder. The ideal powder is one that upon ignition will burn so that the pressure will rise quickly to its maximum and then maintain the same pressure throughout the bore as it forces the projectile out toward the muzzle. Actually the pressure of the powder is a maximum at the beginning and decreases toward the muzzle. Our powder is a progressive one; that is, it burns with increasing rapidity as the projectile moves along the bore, maintaining the pressure as the volume of the gas in the gun increases.

The powder is ignited by means of a primer. Primers are combination, electric and percussion.

Fixed Ammunition indicates that the powder charge, primer and projectile form a single cartridge.

Separate Ammunition indicates the projectile is separate from the powder charge.

B. L. R. Guns use separate ammunition, the powder charge not being in a metallic cartridge case, but contained in bags, usually made of silk.

Rapid Fire Guns use either fixed ammunition or separate ammunition with powder charge in a metallic cartridge case. The gun is a single shot gun.

Semi-automatic Gun is a rapid fire gun which ejects the cartridge case automatically after firing and the breech is closed after loading by means of the tension of a spring.

An Automatic Gun, a gun which fires automatically after the first shot is fired. A Machine Gun is an automatic gun using rifle cartridges.

Field Guns, usually of 3-inch calibre, mounted on a land carriage. Used on shore. The ammunition is fixed —shrapnel.

Armor Piercing Shell, a forged steel, point-hardened shell for penetrating the armor of ships. Carries a bursting charge of high explosive.

Common Shell, cast steel, of same form as armor-piercing shell with a bursting charge of high explosive.

Shrapnel, a cast steel shell body, the body being filled with a number of small balls packed in rosin or sulphur. A small bursting charge exploded by a time fuse breaks up the body and scatters the balls.

Firing a B. L. R. Gun. Shell is loaded, then the powder charge or firing charge; breech closed and primer inserted; firing key pressed or lock string pulled. Firing charge is exploded by primer through ignition charge. Shell moves along bore; rotated by rifling; follows trajectory. Fuse in shell is armed by sudden shock of discharge of firing charge. When shell strikes, plunger in fuse strikes cap in fuse, explodes bursting charge in shell.

In B. L. R. Guns the escape of powder gases to the rear is prevented by means of a gas check consisting of a circular pad of asbestos and tallow held between two steel split rings. The mushroom is forward, the breech plug aft. The mushroom is on a stem which passes through the rings and pad and the breech plug. The system is held together by nuts and lock nuts on end of stem. Of course in guns with cartridge cases, the case itself is tight.

The Breech Plug screws into the screw box. The screw threads are interrupted so that by turning the plug only a part of a revolution, the screw threads on the plug are disengaged from the threads in the screw box, allowing the plug to be withdrawn without further unscrewing.

Gun Mounts. The gun recoils in the slide—hydraulic cylinders are cast in one with the slide. A yoke is shrunk or screwed on the gun to which piston rods are connected. These rods are connected to pistons in the cylinders. The piston and rods recoil with the gun; the cylinders are

stationary with the slide. The slide sets on knife edge trunnion seats, a part of the top carriage. The top carriage is on rollers, permitting it to be trained laterally. The cylinders contain a liquid, glycerine and water mixed. Grooves are cut on the inside of the cylinders. Back of the pistons on the piston rods are heavy counter recoil springs. When the gun is fired, the gun, piston rods and pistons move to the rear. The liquid in the cylinders escapes past the pistons, through the grooves in the cylinder. The springs on the piston rods are compressed by the pistons. Finally the recoil is checked. The springs are under heavy compression. The springs then push against the pistons, forcing the gun back to battery; the motion is damped by the liquid in the cylinders as it again flows past the pistons through the grooves.

UNITED STATES NAVAL GUNS

Calibre (inches)	Length in calibres	Weight of gun (tons)	Weight of projectile pounds	Initial velocity Feet Seconds	Remaining velocity	At 9000 yard penetration (inches)	Danger space 10000 yard (yards)	Muzzle energy (feet tons)
14	45	63	1400	2600	1886	16.7	...	65687
13	35	61.5	1130	2000	1221	8.1	110	31333
12	50	56.1	870	2900	2104	16.4	...	51644
12	45	53.6	870	2700	1945	12.9	...	43964
12	40	52.1	870	2400	1712	12.2	...	34738
12	35	45.3	870	2100	1219	7.2	100	26596
10	40	34.6	510	2700	1826	11.1	140	25772
10	30	25.1	510	2000	1103	5.0	...	14141
8	45	18.7	260	2750	1677	7.7	...	13713
8	35	13.1	260	2100	1040	3.6	...	7948
7	45	12.7	165	2700	1481	4.5	95	8338
6	50	8.6	105	2800	1401	4.3	...	5707
6	50	8.3	105	2600	....	4.0	75	4920
6	45	7.0	105	2250	974	2.2	...	3685
6	40	6.0	105	2150	917	2.1	35	3365
5	51	5.0	50	2150	1183	2.0	...	3439
5	50	4.6	50	3000	1138	1.9	...	3122
5	50	4.6	60	2700	1184	2.7	...	3040
5	40	3.1	50	2300	999	1.9	...	1852
4	50	2.9	33	2800	878	1.2	...	1794
4	50	2.6	33	2500	853	1.2	...	1430
4	40	1.5	33	2000	....	....	...	915
3	50	1.0	13	2700	....	....	...	658

Care and Preservation of Ordnance Outfit

(The Ship and Gun Drill, U. S. Navy)

General Routine and Cleaning:

Routine.—In order to prevent deterioration, the following routine is prescribed for the gunnery department of a vessel in commission:

(*a*) Every part of the battery shall be moved, and all turret equipment, including turret turning gear, tested daily, except on Sundays and holidays, and when coaling ship or heavy weather interferes. Torpedo tubes, air compressors and gas ejectors shall be manipulated once a week; and all guns, if not fired, shall be run in once each year.

(*b*) The bores of guns shall be kept thoroughly clean and coated with oil. They shall be examined frequently, and the coating renewed whenever necessary.

(*c*) All bright steel work in the turrets, including the sword, sword box, arc plates, pivots, etc., of the sights shall be kept lightly coated with vaseline or oil.

(*d*) Before testing any apparatus, the oil cups and grease cups shall be examined to see that the bearings get sufficient lubrication.

(*e*) All the ammunition hoists shall be tested weekly without load, five minutes hoist and five minutes lower.

(*f*) The bores of the guns of the torpedo defense battery shall be treated in the same manner as the turret guns; and frictionless bearings, sword box, etc., shall be vaselined and covered with a piece of muslin.

(*g*) The breech mechanism shall be vaselined and kept in place, and the muzzle closed with tompion and bag.

Cleaning.—As the satisfactory performance of mechanical gun carriages, breech-loading rifles, rapid-fire and machine guns depends in a great measure upon the condition in which they are kept, it is directed that the greatest care and attention be given to keep all parts clean, *properly lubricated* and in thoroughly good working order.

(*a*) All breech mechanism must be cleaned daily, avoiding the use of any gritty substance. The breech plug must be frequently removed from the tray, in order that the bottom threads may be reached for cleaning.

(*b*) Brick dust or gritty substances must never be used on any part of the gun.

(*c*) The parts of the mechanism must never be scraped with knives or metal scrapers, or be defaced or roughened in any way.

(*d*) All bare metal parts of the gun and mount must be kept lightly oiled as a protection against rust.

(*e*) Particular attention must be given to keeping the slope and the origin of rifling well oiled and free from rust.

(*f*) After firing guns of 6-inch calibre and below, completely dismount the breech mechanism and wash every part with warm fresh water and soap; dry carefully, then rub all parts with a well-oiled rag, and assemble the mechanism.

(*g*) Keep rapid-fire and machine guns covered whenever there is a chance of getting coal dust, grit, or salt water on them. Inspect and re-oil the guns once a week. In re-oiling, first wipe off all the old oil, which may have become clogged with dust and grit.

(*h*) If the guns are closed by tompions, these should be withdrawn every fair day, and the compression slopes cleaned and re-oiled.

(*i*) All axles, such as those of trucks, elevating and training gear, yoke and pivot bolts, elevating arc bolts, etc., are to be taken out, cleaned, and oiled once in two months, or oftener if circumstances render it necessary.

(*j*) The ball bearings and friction rollers of R. F. mounts should be kept cleaned and lightly oiled, in order to prevent rusting. The oil channels in the slide of an R. F. mount must be kept clear of dirt, and should be *filled with* oil before the gun is fired.

Gas Checks.—The gas checks should be protected as *far as possible* from the weather, and from everything

which could indent or bruise the pads. The rings or discs should be kept scrupulously clean and well oiled, and the pads should be habitually coated with tallow. After firing a gun the mushroom and gas check should be removed, cleaned, and oiled as soon as practicable. The pads, rings, and discs should, when practicable, and especially after bad weather at sea, be removed, cleaned, dried and oiled.

PAINTING.—Guns are not to be painted in rear of slide over that portion passed by the strengthening band in firing, as in the case of the 4-inch and 5-inch guns. The roller paths must be oiled once a week, and the top carriage raised and rollers taken out and cleaned at least once a quarter. Oil holes must be kept clear and closed in wet weather. Training and elevating gear must be kept clean, and all steel parts well oiled. For this purpose they must be removed at least once a month.

FRICTION DISCS OF INTERMEDIATE BATTERY GUNS.—Friction discs should be kept clean and perfectly free from oil or other lubricants. Washing in lye water and then thoroughly rinsing in fresh water will remove all oil and grease. In discs of the multiple type it has been found that one man, using a 24-inch wrench, can set them up sufficiently hard.

MATERIAL FOR CLEANING LENSES.—For all guns using telescopic sights suitable material for wiping the lenses will be obtained from the gunner's mate or turret captain. No other than the specially provided material will be used for wiping lenses; and lenses will be wiped, even with this special material, only when absolutely necessary. (Lens paper is now supplied.)

DIFFICULTY IN OPENING THE BREECH AND IN CLEANING OR TRAINING GUNS.—This is frequently caused by burrs on the diagonal teeth of the breech plug, or on the worm gearings of the elevating or training mechanism. Undue difficulty of elevating or training any of the more *recent gun mounts* is due to some defect in the individual *mount itself and not* in the design. Frequently this diffi-

culty is caused by a shaft being slightly bent or out of alignment, and can usually be discovered if searched for progressively.

Turrets:

General Care.—All parts of the turret, turret machinery, and gun fittings should be kept clean and free from rust.

(*a*) All working parts should be kept well lubricated. No fresh lubricant should be applied to any part without first removing the old coating and thoroughly cleaning the part. In case the coating is difficult to remove, it should be rubbed away with a rag saturated with kerosene. The use of scrapers is prohibited.

(*b*) Operating levers, valves, valve stems, rollers, roller path, ammunition hoist guides, ammunition cars, rests, handling room truck and turntable, shell-room trolleys and rails should be kept free and clean from paint, and should be occasionally wiped with an oily rag to prevent rusting. These parts should not, however, be considered as bright work.

Painting.—The inside of the turret, including the sides and top, and those platforms not ordinarily trod upon by the crew, should be painted white—preferably with white gloss paint—in order to give as much light as possible. No colored paint should be allowed except that the slits in the sighting hoods should be painted a medium shade of green, as should also a section of the turret roof in front of each telescope. The guns may be either painted white or they may be kept bright and burnished. Tools, racks, and rails should be kept bright and burnished. After they are once put in condition they are easily maintained. If they are not prevented, the men in the turret will try to paint a little more; from time to time, until everything is covered. Either asphaltum, varnish, or brown zinc with plenty of drier in it is a good coating for turret platforms and floors, where oil and water are likely to drip.

The Wire Fall of the Ammunition Hoist.—This

should be kept clean, with a slight coating of oil or graphite and tallow to preserve it. As the wire rope stretches, the slack must be taken up and the hoist tested to see that the automatic " cut-off " stops the motor before the car can strike the block at the turret roof. It is also necessary to remove slack from a stretched wire rope to avoid getting knots in it. A stranded or badly rusted wire rope should be immediately replaced.

PLUG CRANK.—The plug crank should be shipped for all ordinary firing. If firing at extreme elevation it may, in some turrets, be necessary to unship it before firing the gun.

CLOSING BREECH.—Occasionally when the breech plug is closed with too much force the rear end of the plug is lifted slightly in the screw box by the spiral pinion, so that the axis of the plug is not in line with the axis of the bore. Consequently the teeth of the unlocking rack will bear too hard on the spiral pinion, and they are liable to injury when the gun is fired. (This accident occurred on several ships during the bombardment at Santiago de Cuba.) To avoid this, ease back slightly on the operating crank after the plug is entirely closed, and if the plug has been lifted out of line it will be seen to drop down into its proper place. Then close gently to insure proper contact of firing circuit.

USE OF POWER.—When a ship first goes into commission a great deal too much power will be required to run the gear, and in electric turrets circuit breakers will give trouble by frequently blowing. If the gear is run each morning and used every day for Morris tube practice, the trouble will gradually decrease.

GEAR IN TURRETS.—While it is particularly desirable that no unnecessary gear be allowed in the turret or beneath it in the handling room, yet some tools are necessary so that too many trips may not have to be made to the ordnance storeroom. A small vise securely mounted in the turret is almost a necessity, and, besides this, various other tools, spare parts, and material are

necessary. All of this material should be stowed in metal boxes and, as far as practicable, under the floor plating, or in such place that a large shell striking the turret or a small shell exploding inside it would not be likely to displace them. All wrenches, etc., belonging to the turret should be so secured that a severe shock may not send them flying about. No articles should be secured to the walls of turret.

LOG.—A smooth log should be kept by the turret which should show that the gear has been run each day, what repairs have been made, the general work done, and the condition of the turret and mechanism. It should also contain a record of target practice and the names of the men under instruction for pointers, gunner's mates, hoistmen, etc.—in fact, anything of interest. Every turret officer who has kept a turret log has found it very useful.

SEATING SHELL.—Owing to the angle of elevation at which the old types of guns are loaded, the projectile sometimes starts back from its seat after being properly set home. This is very easily and efficaciously remedied by means of two turns of a rope yarn or other small stuff around the projectile just forward of the compression band. The sound will always tell the officer whether or not the shell is home. With mounts using electric chain rammers, or hand rammers, a mark may be placed on the last section of the rammer to indicate when the shell is home.

TURRET LOCKS.—During heavy weather at sea, watch the turret and keep the locks set well home to prevent any motion. Do not attempt to enter the turret locks when the turret is moving.

TURRET TURNING.—(*a*) Before turning a turret, ease up on the holding-down springs of the water shed, or raise the water shed if practicable; see everything clear outside of and in wake of the guns and see everything clear in the handling room.

(*b*) The rollers and roller paths should be examined once a week by the turret officer, who should assure himself of their cleanliness and freedom from rust; and

before turning the turret he should ascertain if the roller path is free of obstruction. The men should be cautioned not to leave tools, cleaning rags, or other implements on the roller path. Much depends upon keeping the rollers and roller paths smooth and clean. A light coating of oil will insure against rust. The training racks should be kept free from rust and be well coated with Albany grease or vaseline.

(*c*) Any defects in the working of the turret motors should be promptly reported to the gunnery officer. If one turning engine or motor is disabled it should be shut off, as the other one will suffice to train the turret at a moderate speed, unless the ship is very much heeled.

Loading and Unloading:

LOADING.—All turrets should be supplied with gear for loading by hand.

During hostilities it may be necessary to keep the guns loaded in anticipation of an immediate attack. In such cases, while awaiting the attack, the electric contact at the breech plug should be kept broken.

UNLOADING.—When an attack is considered no longer imminent, the gun should be unloaded and the powder returned to the magaizne; the shell may be left in the car, if desirable. If the shell cannot be easily withdrawn it may be left in the bore for a few days, if there is a probability of it being required during that period of time. In this case a wooden batten equalling in length the distance between the base of the shell and the mushroom head should be placed in the powder chamber to prevent the shell working to the rear against the plug.

In loading, especial care shall be taken not to injure the gas check slope of the gun. If the slope be injured, the escape of gas to the rear cannot be prevented, and serious damage may result.

POWDER CHARGE.—Powder charges should never be kept in the turret or in the ammunition car, as the change in temperature of that charge would probably insure a

miss with that shot, and, besides, would render its value as a trial shot worthless and misleading. For the above reasons, if in anticipation of an immediate attack the gun has been completely loaded for fifteen or twenty minutes, and the attack is still imminent, the charge should be withdrawn and a new charge fresh from the magazine should be loaded.

CHOKE.—Care shall be taken to see that the choke of guns is not so great as to overcome the clearance between the bore and the bourrelet diameter of the shell. This clearance should never be less than one-hundredth inch.

SEATING.—Every gun shall have the distance from the face of the tube to the base of the seated projectile measured frequently. If, on account of erosion, shell seats are different distances in different guns of the same kind, allowance for this fact should be made in order to eliminate dispersion of fire.

PRIMER SEAT.—In every powder-bag gun great care should be taken to keep the primer seat thoroughly clean and smooth. If the primer seat does not permit close fitting of the primer, primer blowbacks may occur, possibly disabling the firing mechanism. Frequent use of the taper reamer with entailed wear of the primer seat to be avoided.

FIRING MECHANISM.—Every effort should be made to keep the firing mechanism of every cartridge-case gun in thoroughly efficient condition. A defect in the firing mechanism may cause the gun to be fired prematurely.

Gas Checks:

SPARES.—With each powder-bag gun there are issued spare gas check pads and spare gas check rings. These pads and rings are carefully fitted to the guns and are not likely to give any serious trouble.

ADJUSTING.—In fitting a new set of gas check rings or gas check pads they should be very carefully adjusted. The bearings of the rings and pads in the gas check seat should be verified by making chalk marks, parallel to the axis of the bore, in the gas check seat; closing the

breech, then opening it and noting the marks transferred to rings and pads.

LIFE.—The life of a pad is variable. The gas check pads and rings should be protected from the weather and everything that could indent or bruise them. The rings and gas check seat should be kept scrupulously clean and well oiled, using soft rags and pieces of waste. Neither the rings nor gas check seat should be cleaned with any gritty substance, nor should they ever be touched with a file or emery cloth, except in extreme cases to remove a burr or score, which must always be done in the presence of an officer; as, to insure proper checking, these rings must be a most accurate fit. The pad should be habitually coated with tallow, and, after firing, the mushroom and gas check should be dismounted, cleaned, and oiled as soon as possible.

INJURIES.—As the pad is liable to be injured in spite of all precautions, it becomes important to know how serious such injuries are. The pad will perform its function in spite of almost any amount of bruising, if its circumference is intact, even though it has lost a portion of its filling. An exception may be found to this statement in cold weather, when, by the hardening of the pad, its plasticity is much reduced. An injured pad should be replaced, however, if time permits.

With the latest form of gas check the nuts on the mushroom stem should be set up moderately tight and left so. There is very little chance of the pad or rings sticking.

If necessary to fire with a defective pad, give the circumference of the pad a thick coating of tallow before firing. If, after firing, a pad is found to be scored or burned, the front gas check ring is not functioning properly and should be carefully examined for fit and for scoring, and, if defective, replaced with a perfect one.

During practice the pad and mushroom head should be frequently sponged off with fresh water.

HARDENING.—If a pad becomes very hard, soak it in a hot mixture of oil and tallow.

COVER SLACK.—If the canvas covering of a pad appears to be slack at any time, the pad should be rejected.

INSPECTION.—The inspection of the gas check by the plugman is to see that the rings and pad are properly adjusted and that the nuts on the mushroom are set at proper tension. Care should be taken that the pad and rings have not dropped down, as may be the case if the nuts on the mushroom stem are not set up tight enough. The adjustment is correct if the plugman can just turn the mushroom head, using both hands, and if the pad is smooth and intact all around, the rings being flush with it and the plug proper.

SHIFTING.—It is well to always have at hand a net strap which fits snugly over the mushroom head, to use when shifting the gas check pads. At high temperature the gas check pads become soft and sometimes disintegrate after several rounds.

The mushroom will be too hot to touch with the hands when shifting pads, and therefore the necessity for a strap fitted with a net to go over the mushroom head, and also for a small tackle to take the weight. A gas check pad can be shifted very quickly even with a hot breech plug. During action it is not necessary to shift a gas check pad at the first sign of disintegration, as it will check the gas for a number of rounds after the rear wall of the turret has been spattered with asbestos and tallow, but continue to set up on the adjusting nuts of the mushroom stem after each shot and shift the pad at the first opportunity. It must be borne in mind, however, that if too much of the pad be lost there is danger of bending the gas check rings or discs.

Miscellaneous Instructions:

ORDNANCE PAMPHLETS.—The methods of caring for and handling ordnance material set forth in the descriptive pamphlets issued by the Bureau of Ordnance should *be closely* followed.

Before Firing.—Before firing, carefully clear all oil out of powder chamber and from mushroom head.

After Firing.—After firing, wash the gun out with the washing hose and bristle bore sponge; then wash the bore thoroughly with fresh water, and after it is dry give it a good coat of oil. The gun should be sponged and oiled once a week. Fit the bore sponge with two lanyards for hauling it through the gun; cover it with a piece of old blanket and haul it back and forth until the bore is clean and dry; then wrap a piece of well-oiled blanket around a sponge cylinder and haul it through to oil the bore.

Material.—The use of emery cloth, brick dust or similar polishing material should be forbidden on the following named parts of the mounts:

Interior of valve casings,
Piston valves,
Valve faces,
Adjusting screws,
Elevating worm,
Elevating worm wheel,
Elevating pinions,
Hardened plate on spring bar of knife edge trunnion bearing,
Knife edges,
Telescope sights,
Telescope sighting mechanism,
Screw thread on elevating rod,
Piston rods,
Rammer sections,
Sight adjuster.

Recoil Cylinders, Liquid and Care:

Liquid.—The mixture used in the recoil cylinders consists of glycerine, eighty parts by measure, and water, twenty parts by measure. The glycerine used should be free from fatty acids, and the following tests are prescribed:

Add to the sample of the glycerine in a large test-tube about equal bulk of a saturated solution of slacked lime and thoroughly shake the two together. If, after standing some time, sediment is deposited, the glycerine contains fatty acid, and is unfit for use in recoil cylinders.

Take another sample of the glycerine in a test-tube and add about an equal bulk of a saturated solution of acetate of lead. If, after thoroughly mixing and standing for some minutes, a deposit appears, add acetic acid and heat the contents of the tube. If the deposit disappears, or if no deposit appears after the mixing with the acetate of lead, the glycerine is free from fatty acid and fit for use in the recoil cylinders.

Both tests should be made, as one is the confirmation of the other.

CLEANING.—The liquid in the recoil cylinders (glycerine 80 per centum, fresh water 20 per centum) becomes muddy after a time, and the grooves of the cylinders may become clogged from a thick, pasty sediment, which is removed with considerable difficulty. It is therefore directed that the recoil cylinders be emptied, cleaned, and refilled directly after the vessel is commissioned and at the end of each year thereafter, as much fresh liquid being added from time to time as may be necessary. The glycerine must be free from fatty acids and the water clear of alkalies and mineral salts; otherwise it will corrode the inside of the cylinders. When exposed to heat glycerine expands and, if for a long time, gums; and this causes filling in of grooves, checking the equalizing pipe and gumming of the counter recoil check, and any of these will cause a gun to function improperly and sometimes cause enough damage to disable a gun. Gummed glycerine may be removed with a strong lye or soda solution if not hard, but must be well cleaned out afterwards with clean, fresh water. In hot weather, cylinders that have been filled in cold weather may weep; that is, leak around bonnets, filling plugs, and stuffing boxes. This is caused by an internal pressure due to the expansion of the glycerine, and in some of the lighter guns may fail to allow the gun to return to battery. This is remedied by taking out the filling or air-vent plug and allowing the surplus liquid to escape, relieving the pressure.

CIRCULATING PIPE.—The circulating pipe on carriages having two recoil cylinders must be carefully looked after to guard against clogging, and be thoroughly cleaned whenever the cylinders are emptied. Blow through the filling holes to see if the circulating pipe is clear.

LEAKS.—As recoil cylinders occasionally leak, even when they seem quite tight, especial attention will be directed to them during the daily inspection, in order to ascertain whether there is any perceptible leak. Loss of liquid, therefore, will be supplied at once. Before every firing, unless an emergency makes this impracticable, the recoil cylinders shall be invariably examined and filled.

Filling Recoil Cylinders:

4-INCH, 5-INCH, 6-INCH AND 7-INCH.—Depress the gun slightly, remove the filling plugs of each cylinder or the air-plug hole of the opposite cylinder to the one into which the liquid is to be poured. Pour until the liquid runs out of the opposite cylinder.

NOTE.—If the filling plugs are in the front end of the cylinders, elevate the gun slightly; if in the rear, depress the gun slightly. When in any other position keep the gun level.

If there is no air hole, care must be taken to pour the liquid into the funnel in small quantities. Care also must be taken to measure the quantity of liquid poured into the cylinder and to strain it through a piece of bunting or cheesecloth to prevent entrance of dirt.

6-PDR., 3-PDR. AND 1-PDR.—All hydraulic recoil mounts for minor R. F. guns thus far issued to service (except 6-pdr., Mark III) have only one filling hole in the boss on the cylinder. The funnel is placed in this hole, and in all other respects the process of filling the cylinder is the same as previously described.

6-PDR., MARK III.—In mounts fitted with the Driggs-Schroeder gun the shoulder bar must first be removed.

Keep gun level. Take out filling hole plug and side

screw. Screw in filling funnel and pour slowly until the liquid runs out of side screw hole. Replace both screws.

Sights for Broadside Mounts:

YOKE SIGHTS.—The sights for broadside mounts of recent date are of the yoke type, the general principles of which are as follows:

Two telescopes are used, one for pointer and one for trainer. The pointer's telescope is usually located on the left side of the mount and the trainer's on the right side.

The telescopes are fitted with cross-wire illumination, permitting of either day or night use. Most sights are fitted with one telescope, having a checking eye-piece for use in checking up the pointer and trainer.

The eye-pieces of the two telescopes are usually parallel to one another, but this need not be the case; they may be perpendicular to one another if more convenient for the operation of the mounts, as in the case of the balloon and submarine mounts.

In bore sighting, the adjusting of the telescope is made by the adjustment of the cross wires, or by adjusting of the telescope in its holder, or by the adjustment of the telescope itself. The first means of adjustment is now being incorporated in the design of all telescopes, it being considered the most efficient. Telescopes are provided with different types of bearings, depending upon the means provided for the adjustment of same or of the means for fitting to the sight. Telescopes of the periscope type are generally provided with two cylindrical bearings on the sight yoke and are fitted with cross line adjustment. Telescopes that are adjusted in the holder are fitted with spherical bearings, and those that are adjusted by the adjustment of its holder are provided with pentagonal bearings.

The elevation and azimuth graduations for the sights are on adjustable parts that can be set at zero after the telescopes have been bore-sighted.

The sight is operated by the sight-setter, and in both elevation and azimuth from one side of the mount. Illumination of the sight scales is provided for night use, small electric lights being used for this purpose.

The sights are designed to give as long a radius as possible to the sight bar and the azimuth head, thereby reducing to a minimum any errors in readings due to lost motion in the sight parts. The azimuth gear is also provided with an adjustable arc for eliminating any lost motion due to inaccuracy in manufacture or wear in the azimuth pinion and arc teeth.

The sight elevation dial is graduated in yards. The sight bar graduation strip is, on the edge, graduated in yards, which are used as a check on the dial graduations, and on the outer edge in degrees and minutes, which are used as an arbitrary elevation scale.

The azimuth drum is, on some sights, graduated in knots, but on other sights an arbitrary scale represents divisions of one-tenth of an inch on a 100-inch radius, these divisions running from zero to 100, the 50 division line being opposite the index line on the pointer when the sight is set at zero azimuth.

Sights, Care and Adjustment:

CARE.—All working parts of the sight mechanism must be kept free from grit and rust and kept covered with a coating of good mineral lubricating oil. Oil holes are provided in the different sight parts for the proper lubrication of the sight operating mechanism. Sights that are exposed to salt spray should be disassembled, cleaned in alcohol, covered with fresh coating of oil and reassembled. This should be done as often as it is considered by the gunnery officer that the conditions warrant such action. Emery paper or any gritty substance must not be used for cleaning. The sights are so constructed that any lost motion in the bearings and working parts, *caused either by* cleaning with emery paper or wear, will *materially affect* the accuracy of the sight.

Lost Motion.—Sights that are constantly used for Morris tube or dotter practice should be carefully tested for lost motion in the parts. To test a sight for this, proceed as in bore sighting. If lost motion in any of the sight's parts has developed, the refitting of the sight should be done only by a skilled mechanic.

The adjustment of the mount, as well as that of the sight, should be carefully checked. If the gun and the telescope objective are not parallel, there will be a vertical error in pointing, as the gun will not be at the elevation as indicated on the sight scale.

To test the adjustment of the sight and mount, first adjust the trunnion bearing to insure good contact between the elevating arc and pinion, the lost motion in the other parts of the sight and mount having been previously eliminated. Now attach an accurately marked gunner's quadrant to the gun and another to the telescope, move the gun in elevation and depression, and if there is no error the angular change shown on each quadrant will be the same. (Should be done in dry dock.)

Graduation Dial.—Sights are fitted with an elevation graduation dial, which is used instead of the direct reading sight bar graduations, the dial admitting of a finer adjustment of the graduating scale. Lost motion in the sight elevating gear will more readily affect the readings on the dial. The lost motion in this mechanism should be tested as follows: Lay the sight on a distant mark and, by means of the sight elevating mechanism, elevate the sight well above and depress it back to the distant mark, then depress below the mark and back to the distant mark. The ship being stationary, the reading on the dial should be the same each time the horizontal cross wire of the telescope is accurately laid on the distant mark; if not, there is lost motion in the gearing.

The azimuth drum should be tested in a similar manner, using the vertical cross wires of the telescope instead of the horizontal wires.

Azimuth Mechanism.—The lost motion in the az-

ıuth mechanism is eliminated by the adjustment arc in ıe yoke teeth or by the split pinion. There are no means rovided in the earlier marks for taking up the lost motion ı the elevating mechanism, as the weight of the sight ar and head should always keep the teeth of the rack and inion well in contact. Later marks of sights have djustable elevating arcs. This adjustment is accomplished by having an adjustable steel key which carries ıe centre section of each tooth, and which can be set p to diminish the lost motion due to wear of the pinion y advancing the centre part of each tooth sufficiently ɔ take up the play.

)escription of Ammunition:

SMOKELESS POWDER.—Smokeless powder is now used ı all guns except for saluting charges, ignition charges, nd bursting charges. The form now used for all guns ; a single multi-perforated cylinder.

For B. L. guns, this powder is put up in cartridge ags, and the bag enclosed in airtight tanks.

For the 14-inch and 12-inch guns, the charges are ı four sections, two sections being packed in each tank.

For the 10-inch, 8-inch, and 7-inch guns, the charges re put up in two sections, one section in a tank, except ıe 8-inch/35; which has two sections in a tank.

For the 6-inch and 5-inch guns, the charges are in one ection, enclosed in a tank.

IGNITION CHARGES.—At the base of each section an gnition charge is secured, composed of black cannon owder. The ignition end of all bags is dyed a carmine ed.

BURSTING CHARGES.—All armor-piercing projectiles f every calibre are loaded with a bursting charge of xplosive "D" for all guns of 6-inch calibre and above. 'or guns below 6-inch and numerous projectiles still in ervice for large calibre guns, the bursting charge is of lack powder.

The following table shows the weight of the bursting ıarge for projectiles of the various calibres:

Gun	A. P. projectile	Common projectile	Charge
14-inch..........	31.4 pounds...	....	Explosive "D"
13-inch.........	13.6 pounds...	....	Explosive "D"
	22.5 pounds...	....	Black powder.
12-inch.........	24.0 to 24.7 pounds......	....	Explosive "D"
10-inch..........	13.25 pounds..	....	Explosive "D"
8-inch..........	6 to 6.2 pounds	....	Explosive "D"
7-inch........	4.4to4.5pounds	5.50 pounds....	Explosive "D"
6-inch........	2.4 pounds... 1.8 pounds...	4.0 pounds....	Explosive "D"
5-inch.........	....	1.70 pounds...	Black powder.
4-inch.........	....	1.10 pounds...	Black powder.
3-inch.........	....	.50 pound ...	Black powder.
3-inch L and F..	....	.35 pound ...	Black powder.
3-inch High Explosive	....	.33 pound ...	Explosive "D"
6-pounder......	....	1300 grammes.	Black powder.
3-pounder......	....	900 grammes.	Black powder.
1-pounder......	....	180 grammes.	Black powder.

TAGGING CHARGES.—To each bag containing a part of a charge a cloth tag is attached stating:

(*a*) The calibre of the gun for which it is intended.
(*b*) The proportion of the charge that the bag contains.
(*c*) The weight of the charge.
(*d*) The index of the smokeless powder contained therein.
(*e*) The initial velocity given by the full charge.
(*f*) The amount of ignition powder contained in the section.
(*g*) The initials of the inspector in charge of the magazine.
(*h*) The name of the magazine at which the powder is put up, and the date it is put up.

The bag is stenciled as follows: Calibre ———, mark of gun ———, charge ——— (full, ½, ¼, etc.), weight of charge ———, I. V. ———, initials of tag inspector, and number of grammes on ignition end.

Attached to each tank is a tag giving the same information, except that the tag on charge also has *psychrometer reading* and number of weigher and assembler.

FIXED AMMUNITION.—Fixed ammunition is used for *all 5-inch* 40-calibre and smaller guns.

For the 3-inch, 4-inch, and 5-inch cartridges, the powder is put up in bags with an ignition charge at the base, the whole charge being placed in a cartridge case, except in the case where an extension primer is used.

The projectile is forced into the mouth of the cartridge case until its rotating band is at the end of the case.

The 1-pdr., 3-pdr., 6-pdr., and 3-inch landing and field gun charges are simply placed in a cartridge case, no bag being used, the ignition charge being in the primer.

A pasteboard wad is placed over the powder, and a pasteboard distance piece between the base of the projectile and this wad, which holds the powder in place. The projectile is forced into the case in the same manner as the larger fixed ammunition cartridges.

Tank and Box Markings:

FULL CHARGES.—Each tank containing all or part of a full tank is marked with a circular band, two inches wide, of *white* paint on the lid; with the index number of the powder stenciled on the white ground in not less than three-quarters-inch *black* lettering; also with calibre and mark of gun when same is stenciled on cartridge bag.

REDUCED CHARGES.—Each tank containing all or part of a reduced charge is marked with a circular white band, the index number and R/C being stamped on the white ground in not less than three-quarter-inch black lettering.

CARTRIDGE CASES.—The charges for the 6-inch and 5-inch cartridge case guns are put in cartridge cases, and no bags are used where an extension primer is used, otherwise a bag is used. Each case is protected by a wooden ammunition box. Tags giving the same information as that attached to the tanks for the B. L. guns are attached to the boxes for these guns, and the index number of the powder used is painted on the base of the case.

FIXED AMMUNITION BOXES.—All fixed ammunition is boxed *except 4-inch/50* long point, which is put in metal *tanks, not painted* except ends. The boxes are painted

lead color with a fireproof paint. The contents of a box follows:

(*a*) For the 4-inch and 5-inch guns, one cartridge.
(*b*) For the 3-inch 50-calibre gun, four cartridges.
(*c*) For the 3-inch landing gun, six cartridges.
(*d*) For the 6-pounder gun, eleven cartridges.
(*e*) For the 3-pounder gun, sixteen cartridges.
(*f*) For the 1-pounder gun, sixty cartridges.

MARKING AMMUNITION BOXES.—The boxes are painted to indicate the character of the projectile and type of fuse: the 5-inch, 4-inch, 3-inch 50 calibre, 3-inch landing and field, 6-pdr., 3-pdr., and 1-pdr. as follows:

Armor piercing, *all black.*
Forged steel, *all lead color.*
Shrapnel, *all white.*
Blind shell, *red.*

A tag giving the same information as that on the tank is attached to the box; and the index number of the smokeless powder in the charge, also the mark and type of primer, are stenciled on each end and on at least one side.

SALUTING CHARGES.—Boxes containing saluting charges are painted lead color, with top of box half *red* and half *white,* and are marked on top and front in black letters. Saluting charges are made up of black, pea-shaped common powder.

Boxes containing signal charges for signal guns are painted *light blue.*

DRILL CARTRIDGES.—Boxes containing drill cartridges are painted *half black* and *half white,* with *white* and *black* letters.

Projectiles:

DESCRIPTION.—For the 14-inch, 13-inch, 12-inch, and 10-inch guns only common and armor-piercing projectiles are provided. Common shell are not now manufactured *for any gun* larger than 8-inch.

For the 7-inch, 6-inch, 5-inch, and 3-inch 50 guns, *armor-piercing* and common projectiles and shrapnel are

in service. Shrapnel is not now manufactured for any gun larger than 4-inch.

For the 3-inch landing and field gun shrapnel and high-explosive shell are issued.

For the 6-pdr., 3-pdr., and 1-pdr. guns steel shell only are issued.

All of these projectiles and shrapnel are issued loaded and fused, except such projectiles as are issued for target practice only, which do not contain any bursting charge, but are brought to weight with any convenient material.

WEIGHT.—All projectiles of the same calibre are now of the same weight, the common shell having been brought up to the weight of the capped, armor-piercing projectiles.

Following are the weights loaded and fused:

Calibre	Weight	Tolerance
14-inch	1400 pounds...	4 pounds
13-inch	1130 pounds...	3 pounds
12-inch	870 pounds...	2½ pounds
10-inch	510 pounds...	2 pounds
8-inch	260 pounds...	1 pound
7-inch	165 pounds...	¾ pound
6-inch	105 pounds...	½ pound
5-inch/51	60 pounds...	½ pound
5-inch/50	60 pounds...	½ pound
5-inch/40	50 pounds...	½ pound
4-inch	33 pounds...	½ pound
3-inch	13 pounds...	¼ pound
3-inch field...	13 pounds...	¼ pound
6-pounder....	2735 grammes.	....
3-pounder....	1525 grammes.	....
1-pounder....	477 grammes.	....

MARKING.—The major calibre projectiles are marked as follows: On the base, with the name of the manufacturer, lot number, and date of specifications, and weights; on the rotating band, with the initials and stamp of inspector of ordnance, calibre, kind, mark, and modifications.

The minor calibre projectiles have stamped on the

base the name of the maker, and the lot and year of their specifications; and on the band, the inspector's initials.

The exterior of the projectile, except the rotating band, base and bourrelet, fuse, and the ogival for one calibre distance from the nose to the bourrelet, is coated with a thin, hard, smooth paint of the following color:

Armor-piercing	Black.
Common	Lead.
Shrapnel	White.
Blind	Red.

Target projectiles are painted red on the ogival only; the rest of the projectile vaselined.

Projectiles for fixed ammunition are not painted in rear of rotating band, but are given a thin coat of vaseline or heavy grease.

The bursting charge of all projectiles is indicated by painting the ogival a distinctive color for one calibre distance from the nose toward the bourrelet.

Projectiles loaded with black powder have nose lead color.

Projectiles loaded with explosive "D" have nose yellow.

Projectiles blind loaded have nose painted red.

Projectiles fitted with night tracers, and tracer fuses, have a white band one inch wide painted around the ogival just below the color indicating the bursting charge.

Primers:

Single electric primers are issued for drill and testing firing circuits.

For the B. L. guns, only combination primers are now manufactured.

For the 6-inch, 5-inch, and 4-inch R. F. guns a combination extension magazine screw primer is manufactured; also, they use a short-drive primer which requires bag and ignition charge. The short-drive primer is also supplied to 3-inch/50 guns.

For the 3-inch 50 calibre, only combination or percussion extension magazine screw primers are now issued.

For smaller guns, only percussion common primers are now issued.

Safety Orders:

NAVAL INSTRUCTIONS.—No naked light shall ever be taken into a magazine or any other compartment containing explosives of any kind.

Live ammunition will not be used for loading drill.

In every cartridge-case gun, except those of the sliding wedge or eccentric plug type, the breech plug shall not be closed until the gun captain is assured that the front face of the plug is in normal condition.

Locking devices are being developed to prevent the breech of a loaded gun from being opened during salvo firing. Prior to the installation of these devices, whenever two or more guns are fired together, effective measures shall be taken to guard against opening the breech of a loaded gun.

The mushroom of every breech-loading gun shall be thoroughly sponged after each shot.

Copies of all safety orders and instructions pertaining to the armament of the ship shall be kept posted in convenient places easy of access to members of the crew, and all members of the crew concerned shall be thoroughly instructed in them.

It is possible to fire a screw breech mechanism gun by percussion when the plug is swung home but not rotated and locked. Every possible precaution shall be taken to avoid accidents from this cause. If a gun be fitted for electric firing, with contact so arranged that the plug must be fully rotated before the firing circuit is closed, it is not possible for an accident of this kind to happen.

In a powder-bag gun, where the lock is operated automatically, the automatic functioning of the lock should not be interfered with in any way. Should any of the parts operating the breech mechanism and the lock break, and the lock be then operated, the gun might be fired with *the plug unlocked.* Every possible precaution shall be *taken to avoid* accidents from these causes.

As soon as a gun is loaded, the breech shall be closed without delay.

When a gun which has been fired is still warm when reloaded, and it later becomes necessary to remove the charge, the gun need not be fired, but should be unloaded. When it is apparent that the service of the gun will not be resumed within a reasonable time, the powder involved will be dumped in distilled water, and kept in that condition until turned into a naval magazine at the first opportunity.

In preparing a battery for firing, the division officer shall assure himself that the tompion is removed from each gun and that each bore is clear.

The breech of the gun shall never be unlocked or opened while there is a live primer in the lock.

The firing lanyard shall never be hooked to the trigger of the lock until after the breech plug has been closed and locked and the gun primed. The lanyard shall be hooked just before cocking the lock.

The breech of a gun shall never be opened or unlocked while the lock is cocked or while the lanyard is hooked to the trigger.

When the order "Cease firing" is given, loaded guns must be put in such condition as to render accidental discharge improbable. This necessitates for—

B. L. R. guns ....removal of primer.
R. F. guns ....removal of case.

If a crew leave a gun at any time, the gun shall be left in the condition of cease firing.

No cartridge-case gun shall be fired with a breech mechanism in which the firing pin is not completely housed.

As the firing pin of every concentric screw breech mechanism is directly in rear of the primer when the plug is closed but not rotated, the utmost care shall be taken to insure that the firing pin and all parts are in good condition, as the failure of a part of the mechanism might permit the firing of the gun before the plug is rotated.

The danger of a broken firing-pin point or the fusing of metal on the face of the breech plug, due to a primer blow-back, shall be constantly borne in mind and guarded against.

In a cartridge-case breech mechanism having a firing pin held in position by a cotter pin, similar to the 5-inch Mark V mechanism, the cotter pin shall be in place at all times, in order to prevent the firing pin from losing its housing. If the firing pin be not housed, a premature explosion is apt to occur.

The priming of a breech-loading gun while the breech is open is forbidden, and the breech shall be closed and locked before the primer is inserted in the firing lock, except in a breech-loading gun in which the wedge block containing the firing pin is arranged to operate automatically by the functioning of the breech mechanism, in such a manner that the firing pin cannot be brought opposite the primer until the breech is closed and locked.

No force greater than that which can be applied by the hand alone shall be used in loading a cartridge case into a gun. Any cartridge case that does not freely and fully enter the chamber of the gun under the influence of the force of the hand alone shall be carefully extracted and put aside. It shall be properly marked to indicate its condition, and shall be turned in to store at the first convenient opportunity.

The ramming of shells in turget guns by interposing sections of a powder charge between the head of the rammer and the base of the shell is prohibited.

The possible danger of a serious accident, due to opening the breech of a gun too soon after a hangfire, demands the constant exercise of the utmost prudence and caution whenever a miss fire occurs.

Whenever a gun pointer presses the firing key or pulls the lock lanyard and the gun fails to fire, a hangfire shall be regarded as probable, and until an examination of the *extracted primer* discloses the fact that the primer itself *failed to fire no* distinction shall be made between the case

of a miss-fire due to a failure of the primer to ignite and a miss-fire due to a failure of the charge to ignite after the primer has functioned properly.

In time of peace, whenever a miss-fire occurs in any gun, an interval of at least thirty minutes shall be allowed to elapse after the last effort to fire the gun before the breech is opened, except when, in the case of a gun using a breech-loading primer, an examination of the extracted primer shows that it did not fire. In such a case there is no danger of a hangfire, and the foregoing rule need not apply.

Nothing in this article shall be construed as discouraging possible efforts to fire the gun which do not involve opening the breech. The primer shall be removed from a breech-loading gun (using an appropriate tool in order to avoid danger of being struck by the recoil or of injury from a blowback) and a new one inserted and fired, using either electric or percussion mechanism, as seems most desirable, and these efforts shall be continued so long as there is a reasonable chance of firing the gun. A gun using cartridge cases and fixed primers shall be tried again, either by electricity or percussion, or by both, whenever this can be done without opening the breech.

In time of war, when the possible chance of serious danger due to a miss-fire may be overbalanced by the more important considerations of battle, the commanding officer may, at his discretion, decide what interval shall intervene between the occurrence of a miss-fire and the opening of the breech.

The attention of all officers is invited to the necessity for the continuous exercise of the utmost care and prudence in handling of all kinds of ammunition.

Whenever the guns of a vessel are being fired, the fire hose shall be led out as at fire quarters and the fire pumps shall be kept running.

During firing, no ammunition other than that immediately required shall be permitted to remain outside of the magazines.

At target practice there must be assembled on deck no more than the necessary allowance of ammunition for the intermediate or secondary battery guns that are to fire on the next run; but no charge for a breech-loading gun shall be taken out of its tank, nor shall the top of the tank be removed, until immediately before the charge is required for loading. For guns using fixed ammunition and for guns using separate powder charges put up in cartridge cases the allowance required for the gun or guns that are to fire on the next run may be removed from the boxes.

If an ammunition supply test is at any time required, the ammunition used therefor will be target practice ammunition unless the order requiring the test authorizes the use of service ammunition.

No Morris-tube practice shall be held without an efficient bullet catcher securely attached to the muzzle of the gun or suitably secured in the line of fire of small rifle.

In no case shall automatic shutters separating a turret from its handling room be secured in the open position during drills, exercises, or while the guns are firing.

In developing the maximum speed of the cars the shutters shall be carefully watched and such adjustments made as may be found necessary. In case of danger to the shutters a report as to the extent and cause thereof shall be submitted without delay, which report shall state whether the trouble is due to faulty adjustment of the shutters or to excessive speed of the hoist

If the shutters be damaged during target practice so that they can not fulfil their purpose, the guns of the turret concerned shall cease firing, and the firing from that turret shall not be resumed until the shutters of both guns are in working order, unless the hoist is of the trunked-in type, having automatic doors in the handling room which insure the separation of the turret chamber from the handling room, in which case the firing may *continue so long* as those automatic doors remain in *efficient condition.* In case the damage to the shutters

cannot be repaired within a reasonable time, the crew of the turret shall fire the remainder of the allowance from another turret.

As there is an inflammable gas in the chamber of the gun after firing, which under certain conditions may constitute a danger in igniting the exposed charge while the gun is being loaded for the next round, the chamber of every broadside breech-loading gun using charges that are unprotected by metal cases shall be sponged after each discharge before loading. In case of guns of this class, the combined sponge and rammer shall be used, with the bristle dampened with water. The sponge will be entered in the chamber immediately following the shell and shoved home as far as the shell, when seated, will permit, and then withdrawn. When the gun is sponged in this manner it is not possible for inflammable gases or bits of burning powder bags to remain in the powder chamber to endanger the ignition of the charge.

When adequate mechanical means have been fitted for the purpose of promptly clearing the chamber and bore of all gas, fragments of powder bags, etc., and when, after satisfactory trials, the same shall have been approved by the department, the foregoing precautions may be dispensed with; but in no case shall any of the precautions be omitted while using any extemporized blowing appliance, or when the approved appliance is not working at the standard pressure for which it was designed.

In the case of turret guns, where sponging the chamber is impracticable, the danger from "flarebacks," or from the presence of inflammable gases or bits of burning material in the bore after firing, must be avoided by making sure that all parts of the bore are clear before the charge for the succeeding round is hoisted above the turret floor. In order to make sure that all danger of a premature ignition of a charge while being loaded has passed, a sufficient interval of time shall be allowed to elapse, after the breech plug is opened, for the gas and

smoke in the chamber and bore to dissipate; and the top of a loaded ammunition car shall not be brought above a horizontal plane six feet below the axis of the trunnions, nor shall powder-box doors be opened until the bore of the gun is clear.

When firing any powder-bag gun, whether fitted with gas ejector or not, it shall be the duty of a member of the crew to look through the bore of the gun immediately after the opening of the breech and note when the bore is clear, announcing this condition by calling out, sharply and distinctly, "Bore clear." In order to guard against the danger of flarebacks, the charge shall not be exposed at the breech of the gun until after the announcement, "Bore clear."

The sponging of guns using fixed ammunition, where the charge is protected by a metal case, is not necessary, but, before stowing the empty cartridge cases below, steps shall be taken to free them from all inflammable gases. This can best be done by laying the cases on their sides and testing each one for the presence of gases by inserting a lighted taper in each case as far as the bottom, thus setting fire to any inflammable gases, or by washing the cases out with soap and water.

Under no circumstances shall the material of the cartridge bags or strengthening tapes be added to without authority. Should it be necessary to stiffen the charges, additional cloth or tape shall not be used, but, if necessary, the old cloth or tapes shall be retied or replaced by new material similar to the old.

The magazine flap doors of only such magazines as are being used to supply charges shall be opened, the flaps, in all cases, being down except during the time of actual passage of the section of the charge through the door.

There shall not be exposed (removed from the tank) at one time in all the magazines in use more than one charge for each gun, and then only as necessary to supply the demand in the handling room; nor shall there be permitted at any time an accumulation of exposed sec-

tions for more than one charge for each ammunition hoist outside the magazines in the handling room.

A copy of this article shall be posted in every turret and in every handling room, together with other safety orders pertaining to the turret and the handling room.

Before the firing of any gun, other than saluting, the commanding officer shall require that the recoil cylinders have been inspected and filled in the presence of the gunnery and division officers.

Only blind shells shall be used for subcalibre or excalibre practice.

Especial care shall be exercised to see that all sections of powder charges are entered in the chamber with the ignition ends toward the breech.

Fuses shall not be removed from loaded shell except under explicit instructions from the Bureau of Ordnance.

Torpedo air flasks shall be charged slowly to the full working pressure and be allowed to cool naturally by air cooling. Loss in working pressure shall be made up just previous to firing.

The artificial cooling of torpedo air flasks after charging, by spraying with water or by flooding the torpedoes in submerged tubes, is prohibited.

The testing of air compressors by charging torpedo air flasks at the full speed and capacity of the compressor is prohibited.

In handling mines, strict compliance with the current instructions laid down for mining exercise shall be enforced at all times. In all mining exercises the mines shall be handled exactly as they would be were they fully armed, whether such be the case or not.

Conditions not covered by these safety instructions may arise which, in the opinion of the commanding officer, may render firing unsafe. Nothing in these safety instructions shall be construed as authorizing firing under such conditions, or as preventing the commanding officer from issuing such additional safety orders as he may deem necessary.

CHAPTER XXXI

ELECTRICITY IN THE NAVY

BY LIEUTENANT COMMANDER C. S. M'DOWELL, U. S. NAVY

No attempt will be made to go over the historical part of the use of electricity in the navy. In the past twenty years the various applications and known uses of electricity on land have increased rapidly. The uses of electricity in the navy may be said to have kept up with the development of the art as applied on shore, and in many cases have kept ahead of it; electricity is put to numerous uses on board ship when, for economical or other reasons, it has not been used similarly to any extent on land. Military expediency sometimes takes precedence over cost, and, again, because of the conditions, some uses of electricity are more economical on shipboard, while the reverse might hold on shore. The size and com licated equipment of battleships have advanced as rapidly as the known uses to which electricity may be put, so that at present the navy makes use of most of the known applications of electricity.

The various applications of electricity on a modern battleship will first be described in a general way, and then the modern uses of electricity which are found on some of the other ships because of the special uses of those ships.

Material.—Because of the particular character of the service experienced on shipboard, and especially on ships which must be prepared for hostilities, many materials found suited for use on shore have been discarded entirely, or to a great extent.

The first and most important object in the design of any electrical apparatus or material for ship use is to obtain that which will be the most reliable under all the *conditions which* could possibly be met. As ships are

often stationed far from a home port where it takes months to get renewals and spares, the question of reliability is of great importance, even in peace time. Thus, to obtain insulating materials which would stand exposure to salt moisture, great temperature variations, shock of gun-fire, etc., the navy has carried out tests for the past few years and established a list of approved insulating materials. These materials have been developed both for low tension use and for the high-voltage frequency, as experienced in radio apparatus.

In order to prevent deterioration and corrosion the navy specifications call for interior bolts, nuts, pins, screws, terminals, brush-holder studs, springs, etc., to be of non-corrodible material or of steel thoroughly sheradized or heavily copper-plated. Some materials which are being used to a great extent on land are entirely unsuited for ship work; thus aluminum cannot be used because of the effect on it of salt air and moisture. The attempt is made to follow the best commercial practice, but many cases arise in which special material must be used, and the above are given as examples.

The question of personnel must also be considered in the course of design and construction of electrical apparatus for the navy. The navy maintains electrical schools for the training of electricians, and the naval electricians, as a rule, are competent, but much of the apparatus must be handled by men who are not electricians and, therefore, must be fool-proof. This is especially true in the turrets.

Generators.—The latest battleships are being equipped with four 300 K. W., D. C. turbo-generators, equipped with mechanical reduction gear. The use of reduction gear allows more economical operation and also saves space and weight. The navy has recently adopted 240 volts as standard generator voltage. In the present state of development it was not considered wise to use 230-volt tungsten lamps, so a three-wire system is being installed, both three-wire generators and balancer sets

being tried out. The three-wire system is only between the generators and the distribution boards, the power leads from the distribution panels, of course, being on the 230-volt outside leads. One side of the ship's lighting circuit is from one outside bus to neutral and the other side of the ship being wired from neutral to the other outside bus. The auto-transformer or balancer, as the case may be, is of sufficient capacity to carry the unbalanced lighting load, including searchlights.

Wiring.—The navy, for a number of years, made it a standard practice to run all wiring in conduit. This wiring has required numerous renewals to clear the lines of grounds and short circuits, and the policy has been reversed, and all wiring is now lead covered and armored by steel braid or armored alone. Among the reasons for this change were that the conduit tended to fill with water, due to condensation; it was more expensive to install and hard to make water-tight joints through water-tight bulkheads. The armoring is for mechanical protection and also as a shield to protect the circuits from the inductive effects of the radio currents.

The navy uses a 40 per cent. pure Para rubber compound for ship insulation. In high temperature locations, as in engine-rooms and fire-rooms, all rubber insulation has been found to give trouble, and cambric or paper will probably be used for these places in the future.

Lighting.—The use of electricity for lighting was the first application of electricity for ship use, but it has now become a small part of the total electrical load. This lighting load amounts to about 75 K. W. on a modern ship. Extensive tests have been made on vibrating and bumping platform to determine the relative life of carbon and tungsten lamps under service conditions, and, as a result of these tests, tungsten lamps have been adopted for all places except for portables. Two hundred and fifty watt units are used for lighting in fire-rooms and engine-rooms; the rest of the lighting is, as a rule, by 40-watt units.

The lighting system is divided into two separate classes of service, "Battle" and general lighting. The "Battle" circuit covers the lighting necessary when the ship is darkened for night attacks.

There is, in addition, an emergency lighting circuit of 20 volts supplied by storage batteries, which cuts in automatically when the circuit breakers on lighting circuit trip. Portable safety lamps for use in coal bunkers, storerooms, etc.

Some of the numerous motor applications on shipboard are:

Turret turning;	Meat cutters;
Gun elevating;	Potato peelers;
Capstan;	Egg beater;
Deck winches;	Ice-cream freezers;
Boat cranes;	Dish washers;
Steering gear;	Laundry motors;
Hull ventilation;	Refrigerating machine motors;
Forced draft;	Motor pumps;
Machine tools;	Air compressors.
Dough mixers;	

A few of the distinctive motor applications now will be brought out in a general way.

Steering Motors.—Until within the last few years it has always been considered necessary to use steam steering engines; as the reliability of electric motors became more generally known, various experimental electric steering systems were installed as auxiliaries. At present both electric and steam are installed, but electric steering is actually used the greater part of the time when installed, and, it is probable, will supersede entirely the steam steering gear. The present practice is to use a master controller with two speeds in each direction; the steering motor itself is operated either from a contactor panel and the voltages regulated by resistances, or Ward-Leonard system of control used. There are usually four or more master controllers situated at various steering stations on the ship, with a selective switch in the steering engine-room for connecting any one of the master con-

trollers to the steering gear. There was at first great opposition to eliminating the follow-up systems, but this has been mostly overcome.

Variable Speed Gear.—One of the special applications of apparatus to shipboard is the control of the turret training motors and the gun elevating motors by the Waterbury variable speed gear. One end, the "A" end, of the gear runs at a constant speed in one direction, while the other, the "B" end, by control of the tilting box, can be made to run in either direction, from zero up to the speed of the "A" end. The efficiency of this gear at full load is a little over 80 per cent. The necessity for very fine control in the handling of guns in order to keep them on the target while the ship is rolling and pitching is evident, and this gear has admirably met the purpose.

Ventilation.—As most of the compartments on a battleship have no air ports, it becomes necessary to install artificial ventilation. The hull ventilation may be obtained either by forcing the air in or by exhausting it; the usual practice in the ordinary compartments is to force the air in by motor blowers and allow the heated air to find its way out. In certain compartments, however, where special ventilation is needed, both systems are used. An example of this is in the sick bay. The specifications require a certain number of complete changes of air in the various compartments in one hour.

Refrigerating Plant.—Refrigerating machines are installed for furnishing ice, for cooling cold-storage rooms, drinking water, etc., and for cooling the magazines. The present practice is to use motor-driven CO_2 machines. One of our latest ships has six machines, each rated at six tons of ice per day; these machines are each driven by 15-horsepower motors; the brine circulating and condenser pumps are also motor driven.

Machine Tools.—A battleship must be, to a certain *extent, self-sustaining,* so that a machine shop capable

of doing the ordinary small repair jobs is a necessity. The present practice is to use electric motors with individual drive. In connection with foundry and blacksmith shops, this makes the ship practically self-sustaining. The fleet is provided with repair ships.

Gyro Compass.—This is a special application of electricity on shipboard, the electrical features of which are not especially complicated, but which must be worked out to an extreme nicety in order to be reliable at all times. The sensitive element or gyro wheel is the rotor of a three-phase induction motor. The sensitive element through trolleys and contactors works a relay which controls an azimuth motor; the azimuth motor, through gearing and rack, moves the compass card in the same direction and through the same angle, from the fore-and-aft line of the ship, as the sensitive element holds to the north, and the ship moves under it. The gyro compass, because of its large directive force, which is unaffected by the iron around it, can be placed below the water-line and behind heavy armor. The compass card on the master is connected through suitable gears to a transmitter which energizes in rotation the six poles of the repeater compass motors; the rotating magnetic field thus created drags around the armature of the repeater motor and through suitable step-down gears keeps the repeater compasses in step with the master compass. The repeater compasses can be placed wherever desired. The use of the gyro compass has enabled ships to steer a much straighter course, as the compass is much more sensitive and lag is eliminated, and thus eliminates, to a great extent, the errors of dead reckoning covered up by the general term of "set and drift." A ship on a regular run would make an appreciable saving in coal because of the shorter distance run when using the gyro compass.

Electric Cooking and Baking.—Because of the fact that electricity at present on board ship may be considered as a by-product and very cheaply generated (the cost of it in a modern ship is estimated to be less than one cent per

kilowatt-hour) the use of electricity for cooking and baking becomes a practicability. On our two latest battleships, the crew of each of which is over a thousand men, all the cooking and baking is done electrically, except for some steam kettles in the crews' galley. There are fifteen ranges installed on the latest ships, and two bake ovens. The peak load during the dinner period is about 140 kilowatts. The bake-ovens have a capacity of 100 loaves. From tests made to date it seems that the total consumption per person for cooking and baking will average about 1.25 kilowatt-hours per day.

Air Heating.—The electrical plant of a modern battleship may be considered as an isolated plant operating at a very low load factor; the adding of additional load, so long as it does not come under battle conditions, does not increase materially the operating cost. For this, if for no other reason, electricity for space heating is a practicability. Electric convectors are now installed for heating spaces far removed from the boilers where the steam losses would be great or where the steam pipes would have to pass through water-tight bulkheads. The improved service, with freedom from leaks, noises, and disagreeable odors, makes its use particularly applicable for stateroom and small-space heating.

Electric Sterilizers.—Another special application of electricity in the navy is the use of electric sterilizers in the sick bay. The reduction in long steam leads, the saving in cost of installation, and the reliability of service and cleanliness, are the advantages of this apparatus.

Searchlights.—Searchlights are installed for use in peace, for picking up buoys, land-marks, boats, etc., for use in coaling ship and taking on stores at night. Their use in war is principally as a defense against night attacks. Searchlights are installed at various places on the ship so as to cover the whole horizon, and are usually controlled from a distance, this control being, as a rule, electric on modern ships. Their use in war is for searching and for illuminating the target after it is picked up.

Thus in motor-controlled searchlights two speeds of train are usually provided—one so that the total arc assigned to a particular searchlight may be quickly covered, and the other so that small movements may be made after the target is picked up There has recently been devised a searchlight which for the same diameter of mirror gives approximately four times the intensity of illumination as those used in the past.

Signalling and Telegraph Systems.—It would be hard to conceive of a modern battleship without electricity for signalling from ship to ship, ship to shore, and, of most importance, for interior communication.

Included in the signalling systems are radio, blinker lights, ardois, semaphore signalling, and submarine signalling. The interior communication includes the following circuits and systems:

Engine Order Telegraph.—This transmits messages from the bridge to engine-room, and indicates the speed to be made, ahead or astern.

Engine-room—Fire-room Telegraph.—This system transmits messages from the engine-room to fire-rooms, indicating the boiler power required, and other orders as necessary to keep the fire-room informed of the needs in the engine-room.

Course Transmitter.—This transmits the course from bridge to steering engine-room in case steering is being done from the latter place.

Rudder Angle Indicator.—This indicates to the helmsman the displacement angle of the rudder. It is especially necessary when a follow-up system of steering is not used.

Revolution Indicator.—This indicates on the bridge the number of revolutions being made by the main engines, and direction of revolution—ahead or astern.

Warning Signal System.—This system consists of a number of contact makers and electric howlers which are used to give the signal for closing the water-tight doors and hatches.

Water-tight Door Indicator.—This system, by means of contacts on the water-tight doors, indicates by lights on a board situated on the bridge or elsewhere when the water-tight doors are closed.

Pyrometer Indicator.—This indicates the temperature of the gases in the smokestacks. A thermo-couple is placed in the base of each stack, and the indicator is installed where desired.

Telephone Systems.—There are three distinct telephone circuits on a modern ship:

Ship's service telephone circuit;
Fire control telephone circuit;
Manœuvring telephone circuit.

These are supplied with current from motor generators or storage batteries. All lines are two-wire. There are about 170 telephone stations on the ship's service circuit; this circuit is equipped with the regular commercial type of switchboard. The fire control telephones are equipped with head-piece and breast transmitter, no calling circuit being used. These transmitters are installed where desired, to transmit necessary battle orders. The manœuvring telephone circuit provides communication between the bridge, engine-rooms, steering gear, and steering engine-rooms. The transmitters and receivers are similar to the fire control type.

Fire Control.—The term "fire control," as used in the navy, is misleading to the layman; it covers all the apparatus and circuits installed for the control of the turrets and other guns, the transmitting of ranges and battle orders; it is in effect, the nerves of the ship when in battle or operating under battle conditions. Practically all this apparatus is electrical, and some are examples of very ingenious applications of electricity.

Submarine Signalling.—The use of radio has proved of great advantage in communication from ship to ship and from ship to shore, and a large number of marine

disasters have been avoided by radio calls for help. On account, however, of the difficulty in determining the directions and distance by the assisting ships, there has, therefore, been developed a system of sound signalling using the water as a medium which will indicate the directions of the calling ship or signalling station. In its latest development, as invented by Professor Fessenden, the side of the ship or end plate on a water tank is used as a vibrator, this diaphragm being rigidly fastened by a rod to the armature of the reciprocal generator. The oscillator may be placed inside, using the side of the ship as a diaphragm, or suspended over the side of the ship. The oscillator acts both as a transmitter and receiver. Signals may be sent by a regular telegraph key, or, by using a telephone transmitter in the alternating circuit, conversation may be carried on for some distances up to about one-half mile. Two oscillators are used, one on each side of the ship, and the direction of sending station obtained by turning ship until signals of equal intensities are received from both sides. This system may be used to get the depth of water by taking elapsed time between signal and echo, and some experiments have been made with it to determine the distance of icebergs.

Radio Telegraph.—The development of radio telegraph has introduced a new use of electricity for marine service. There is practically not a navy ship afloat to-day without a radio set; even the submarines have their radio sets, with masts which can be dismounted before submerging. The navy uses generally, at present, 500-cycle, motor generator quenched gap sets, although some tests have been made on arc sets for ship use, and it is probable that the radio sets of the near future will be some type of continuous oscillation sets.

Electric Propulsion.—Although no battleships are as yet equipped for electric propulsion, this system has been tried out on an auxiliary ship of 20,000 tons, and the results have been very satisfactory. Some of the advantages of this system are that the turbines may be run

at a high speed with a corresponding decrease in space and weight and a gain in efficiency, while the propellers driven by the motors can be run at a low speed with a gain of efficiency. It is, in effect, an electric reduction gear, with the advantage over mechanical gear in that the ratio of reduction may be changed by changing the number of poles of the motor or by changing the number of phases, or both. It has the further great advantage for manœuvring in that the turbines do not need to be reversed in reversing the propellers, so that with electric propulsion the propellers may be reversed nearly instantly and an equally high torque obtained in either direction. The navy has decided upon the adoption of electric propulsion for the new battleships.

Submarines.—The application of electricity for use in the navy is strongly brought out in the case of the submarine. The submarine was developed and tried out one hundred years before it became of any practical use, mainly because no suitable power was available for use when submerged. The advent of storage batteries and motors resurrected the dormant idea. Lead batteries have been used exclusively in the past, but tests are now being conducted to determine the advantages and disadvantages of the lead and Edison type for this particular service. The present submarines are driven on the surface by Deisel engines; the battery may be charged while running on the surface by connecting the motors to the oil engines and using them as generators, or they may be charged from the submarine tender. The advent of the gyro compass has greatly increased the usefulness of the submarine by making it possible for them to be steered on straight courses without the necessity of coming to the surface so often to get bearings. Their chances of getting within striking distance are thus greatly enhanced. A submarine is equipped with vertical and horizontal rudders, both of which are motor operated. As a submarine is built to run submerged and electricity is the only power available when submerged, the present submarines are

heated electrically and fitted with electric stoves. They are fitted with radio telegraph sets and also with submarine signal sets.

At the present time, with many of the principal powers engaged in war, it behooves us all to think of our preparedness for defense; although great advances have been made, there are many problems still unsolved. The navy is very glad to have engineers become interested in them. It has been said that the moss-backed sailormen of the wind-jammers have been replaced in the navy of to-day by mechanics: it looks as if the sailor of the future will be mostly an electrician.

CHAPTER XXXII

ENGINEERING IN THE NAVY

It is impossible, within the limits of a chapter, to give more than a cursory review of the subject of engineering in the navy. However, a description will be attempted to trace the progress in engineering from the old reciprocating engines and Scotch boilers of low pressures to the modern steam turbine installations receiving steam from high-pressure water-tube boilers.

All must understand that with steam machinery the boiler is the source of all power. The earliest boilers were fire-tube; that is, the flames and gases passed from the combustion chamber in the back of the fire-box through tubes to the smokestack. The water surrounded the fire-tubes and was contained within the boiler shell. The boilers were in early design of very low pressure, but as progress was made pressure became higher until 200 and 250 pounds of steam was being carried.

From a naval standpoint, the most serious disadvantage of the fire-tube or Scotch boiler was the time required to raise steam. From ten hours to a day was considered necessary to raise steam in a cold boiler. To raise steam quicker brought severe strains, due to unequal expansion of the metal, causing leaky tubes and gaskets. In addition, the fire-tube boilers were heavy and occupied much space relative to the power developed.

The water-tube boiler took the place of the fire-tube one. In the former the water is contained inside tubes, and the flame and gases from the furnaces surround the tubes. The tubes connect into a steam drum at the top of the boiler, from which the steam pipe conveys the steam to the engines. With the water-tube boiler steam can be raised quickly without danger to the tubes or the boiler.

It is evident that a warship cannot keep fires lighted

constantly under each of its many boilers: the expenditure of man-power and fuel to do so would be prohibitive; yet a warship at sea during war and in the vicinity of an enemy must be capable of steaming at high speed as soon as possible. To be obliged to wait ten to twenty hours could not be considered, and this important fact forced an early adoption of the water-tube boiler, in which steam can be raised inside of thirty minutes.

There are several types of such boilers installed in our naval vessels. Among them are: The Babcock and Wilcox, Niclause, Thornycroft, and Normand. The former boiler finds most favor in our larger ships.

The first steam engines installed on naval ships were horizontal; that is, the pistons travelled horizontally. Due to excessive friction and unequal wear, vertical engines were soon designed and installed in later warships.

The older warships of the United States Navy in commission, including battleships, armored cruisers, and cruisers, are propelled by reciprocating engines. They are termed vertical inverted triple-expansion engines, and two sets are installed in each ship, one on a shaft. The indicated horsepower developed, or the I. H. P., ranges from 9000 in the old battleship "Indiana" to 25,000 in the more modern battleship "Delaware" and 28,100 in the "New York" and "Texas." In the latter reciprocating engines of four cylinders are used instead of three, the order being: (1) High Pressure, or H. P.; (2) Intermediate Pressure, or I. P.; (3) Low Pressure, or L. P., and (4) Low Pressure, or L. P. Two low-pressure cylinders are used instead of one, for the good and sufficient reason that with the large power developed the volume of exhaust steam becomes so great that a single low-pressure cylinder would be too large for convenience. The naval engineer reverted to the reciprocating engine in the "New York" and "Texas," due *to faults which* developed in the turbines of earlier battle*ships. These* have now been corrected.

Torpedo boats and torpedo-boat destroyers of the earlier types were fitted with reciprocating engines. As high as 7200 I. H. P. was developed in the torpedo boat "Stringham." As many as five cylinders were used on a shaft, the engines being vertical inverted quadruple-expansion, with two low-pressure cylinders.

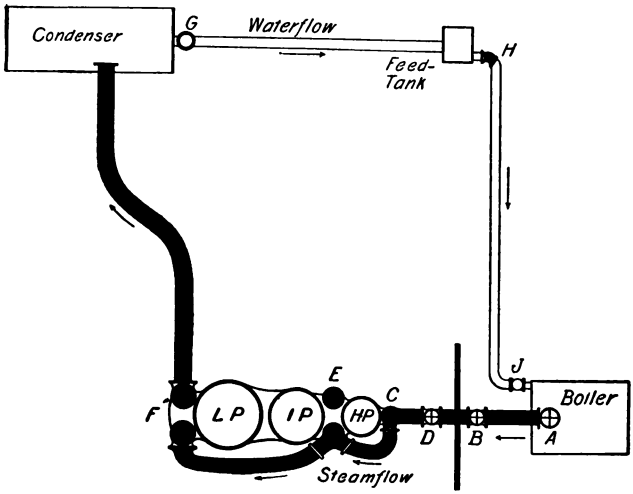


FIG. 31.

A. Boiler stop valve. *B*. Bulkhead stop valve. *C*. H. P. Valve. *D*. Engine stop valve. *E*. Intermediate receiver and valve. *F*. Low-pressure receiver and valve. *G*. Air-pump. *H*. Feed-pump. *J*. Boiler check valve.

Steam travels along the black lines of drawing. From boiler through valve A, B, D, into H. P. valve chest and C and into H. P. cylinder, exhausts after doing work into E, then through I. P. cylinder, exhausts after doing work into F, then through L. P. cylinder, exhausts after doing work into condenser. Water travel from condenser is shown from condenser through G to feed tank, then through H to boiler through J.

Through the tubes of the condenser sea-water circulates, and the exhaust steam impinging on the tubes drops down to bottom of condenser as water vapor. It is

pumped by the air-pump G into the feed tank. The feed-pump H pumps fresh water from the feed tank through the check valve J into the boiler.

The universal demand for high-speed warships of all types increased the size and speed of revolution of the reciprocating engines to its maximum. Engineers naturally looked for another means of utilizing the power contained in the steam to obtain a higher number of revolutions of propeller shafts. The steam turbine was the solution.

All of the very latest battleships and destroyers are fitted with turbine machinery.

The reciprocating engine utilizes the expansive properties of steam to drive a piston up and down—lineal motion—and, through the agency of piston rod, cross-head, connecting rod, and crank, converts this lineal motion into circular motion, thus revolving the propeller shaft. The steam turbine is based upon the well-known principle that when steam is permitted to flow freely from a higher pressure to a lower pressure it expands, and in expanding gains velocity, due to the conversion of the internal pressure energy into kinetic energy. The kinetic energy gained by the steam in freely expanding is equal to the amount of heat units liberated during the expansion. This kinetic energy of the steam is utilized to do useful work by turning the turbine.

Two classes of turbines are employed—the impulse turbine and the expansion turbine.

In the former, the steam is expanded in so-called nozzles and given a very high velocity of flow; it then is allowed to impinge on the blades of the rotor, revolving it at high speed. Curtiss and DeLaval turbines are of this class.

In the expansion type, the expansion of the steam is progressive in each set of rotor blades in very much the *same manner* as steam is allowed to expand in a reciprocating engine. In this type steam velocities are moderate. *The Parsons* turbine is an example of this class.

A very high speed of shaft rotation can be obtained with either type of turbine, and power is practically unlimited.

When high speeds of shaft rotation are used, propellers must be necessarily small, and ships with small propellers are not considered efficient in tactical manœuvring. The backing power of a small propeller is relatively small. This fault necessitated some means of reducing the revolution of the shaft while maintaining the power.

Turbines run most economically at high speeds; while running at low speeds much steam is lost and does no useful work. It, therefore, is desirable to run the turbines at their full designed speed and reduce the propeller shaft speed by some method of gearing.

This has been done, and the turbine machinery to accomplish this is termed "geared turbines." The turbine shaft drives a gear wheel with a small number of teeth, which in turn meshes into a gear with a larger number of teeth. Any ratio of turbine and shaft speeds can thus be worked out.

The same principle also has been employed electrically in what is termed the "electric drive" to be installed in our new battleships and battle cruisers.

Turbines are not as economical as reciprocating engines, and in consequence the radius of operation of ships with turbines is smaller than that with the cylinder engines. In destroyers, in addition to turbines, reciprocating engines have been installed on the same shaft; the latter to be used when steaming at low speeds and the turbines used only when high speed is demanded. A clutch disconnects the reciprocating engines from the turbine shaft.

In all the later ships of war fuel oil is burned in the boilers instead of coal. This liquid has proportionally increased the steaming radius. In other words, a turbine engine oil ship will have about an equal steaming radius as a reciprocating engine coal ship.

Machinery development has been prodigious. The re-

cent battleships laid down will develop nearly 50,000 I. H. P. with a displacement of about 35,000 tons. As many as four propeller shafts are employed. The I. H. P. of the machinery of the latest destroyers is nearly 20,000, and when one considers that the vessel's tonnage is scarcely more than 1000 tons, or one thirty-fifth of that of a battleship and yet has one-half the power, some idea of the enormous power within such a small space can be realized.

Engine designers in the navy have given a large amount of attention to the economy of their designs. It is evident that a warship must husband its fuel supply. The longer a warship can remain at sea in active service the more valuable does the vessel become. A warship whose machinery is so uneconomical as to be continually refuelling is a great care to the commander of a naval force. Naturally enough, the campaign for economy started at the boiler, the source of all power in a steam-driven ship.

Boiler efficiency has varied but little in many years; the greatest effort has been put upon reducing the waste or increasing the economy of the machinery. The burning of oil, eliminating much of the human element involved—stoking—has opened up a new phase. Now scientific investigation shows that, by improving the design of burners through which the oil is sprayed, an improvement in combustion results.

It had been accepted as a principle that the water circulation and the hot-gas circulation should be in the same direction; upon this principle almost all modern boilers have been designed. Recent investigation seems to show that this principle is in error: that the gases should pass in a counter-direction to the flow of the water in the boiler tubes, and that, as the gases cool by giving up their heat to the water and thus decrease in volume, the areas of gas passages should proportionally be reduced in consequence. These discoveries may greatly increase boiler efficiency and economy.

The war in Europe has hastened engineering development. Warships have been tried out under the most severe conditions. The direct turbine drive had already superseded the reciprocating engine; now turbine reduction gear and electric drive will in turn drive out the direct turbine drive. Many of the engine auxiliaries are now driven by turbines instead of reciprocating engines.

The change from reciprocating engines to turbine machinery made the engineer look to his economy of fuel, for a turbine is not economical at anything but its designed speed. The search for economy has caused the consideration of the Diesel engine for installation in other types of warships than submarines. A two-cycle Diesel developing 5200 horsepower has been recently installed in a collier for test.

The submarine engine represents one of the most difficult problems in internal combustion engineering, and each new installation represents the highest state of the art at that time; consequently, the history of the development of the submarine engine is the history of the development of the internal-combustion engine. In every case where some type other than the internal-combustion type has been used the reason has been that satisfactory internal-combustion engines were not available.

The reasons for the universal use of this type of engine are not far to seek. In the first place, the boat must be able to submerge quickly. With internal-combustion engines it is only necessary to stop the engines and close the valve in the exhaust piping, to keep the water from flowing back into the cylinders, and the boat is ready to submerge immediately, so far as her machinery is concerned. All of this is only a matter of seconds rather than of minutes. Furthermore, there is very little heat radiated from the engines themselves, which is a matter of considerable importance to the comfort of the engineers in the confined space in a submarine. All of the boats have motor-driven, cooling water-pumps, and, when the boat submerges, the pumps are kept running in

order to cool off the engines and thus keep the temperature in the engine-room from rising, due to the heat radiated from the engines, because when the boat is submerged it naturally cannot be ventilated as it is on the surface. The question of ventilation is an important one even on the surface, and here again the internal-combustion engine has a decided advantage. Compared with steam equipment there is very little heat radiated from the engine itself, because all the cylinders and such parts which are naturally hot inside are water jacketed outside, and, since the temperature of this jacket water is seldom over 100 degrees, the heat is not uncomfortable. In addition, there is an excellent circulation due to the enormous amount of air required by the engines. The engine-room ventilation is so arranged that the air used by the engines acts as ventilation air, and thus the old air is being continually used and is replaced by fresh air through the ventilators.

The natural fuel for a submarine is a liquid. It is easily loaded through a hose line and can be carried in tanks which otherwise would be inaccessible. Moreover, liquid fuel, such as gasoline, kerosene, and fuel oil, contains more heat units, which means more power, for a given weight and space than does solid fuel, such as coal. When it comes to using this fuel in an engine the internal-combustion engine has a big advantage, because it uses only about one-third as much fuel for a given power as does a steam engine plant, for instance. This means that if a boat has fuel tanks of a given capacity it will have the longest cruising radius when fitted with internal-combustion engines, and this is very important from a military standpoint.

The first submarines built for the United States Navy were of the Holland type and are known to-day as the "A" boats. These were single-screw boats and were equipped with 160-horsepower gasoline engines. They were placed in commission in 1903, and, although they *represented* the best that was known at that time, they

soon appeared out of date, due to the rapid advances in the arts of building submarines and of building internal-combustion engines.

In 1907 the next group of boats, now called the " B " boats, were placed in commission. These boats were still single screw, but had 250-horsepower engines and a surface speed of 9 knots, as against 8 for the "A" boats.

Submarines were now making rapid strides in size, and in order to keep the same surface speed for the " C " boats, placed in commission in 1908–'09, it was necessary to provide twice as much power as for the " B " boats, and twin screws were used for the first time.

The " D " boats followed the " C " boats, with a little more power and with improved engines, but still of the gasoline type. They were commissioned in 1909–'10.

It had been realized, previous to this, that gasoline as a fuel was not all that could be desired, on account of its volatile nature, particularly in the confined atmosphere for a submarine, but no type of engine other than the gasoline had been developed to such an extent as to warrant its adoption in submarine service. The first successful Diesel engine had been built in 1897, but this was of the stationary type and, of course, was very far from being the engine that we know to-day. Strange as it may seem, it was not until 1902 and 1903 that the Diesel engine first began to be appreciated, even in the stationary field, and not until 1905 were serious attempts made to adopt this type of engine to submarine service. Some three years later, the Electric Boat Company, introduced the marine Diesel engine into this country for use in the " E " and " F " boats, which were placed in commission in 1912. These engines were of the four-cycle non-reversible type and did service until recently, when they were replaced by Diesel engines of a later design.

There are four boats in the " G " class—three of the Lake type and one of the Laurenti. All have gasoline engines except the " G-3," which has two-cycle Diesel engines of foreign design and build.

The " H " boats, all of the Holland type, were commissioned in 1913–'14 and are equipped with two-cycle Diesel engines of the Nuremberg type. The " K " boats and all of the " L " boats now in commission are also equipped with Nuremberg two-cycle Diesel engines. The new boats now under construction are having some two-cycle and some four-cycle engines installed, but all are of the Diesel type. As has already been mentioned, the first Diesel engines built in this country were copied from foreign designs, but the present-day engine in the Holland type of boats is an exclusively American product and is the result of the experience gained in service with the foreign designs.

In order to appreciate what it means to develop a new type of engine, it must be remembered that it usually takes eighteen months to two years to build a boat, and then the boat should see at least a year's, and, better, two year's, service before any definite conclusions can be drawn. In other words, actual accomplishment is always at least two or three years behind what is known to be the best design.

Mention has already been made of the greater and greater demands being made on the power plants of submarines in order to drive the bigger boats and to get the high speeds demanded for present-day requirements. This has led to some very interesting developments in connection with the power plant design as a whole. First the boats were single screw; then twin screws were used. The first engine was a four-cylinder affair; then six-cylinder engines were used; after that came bigger cylinders, and then eight-cylinder engines. Finally, for the high speeds demanded for the fleet submarines, four six-cylinder engines are used with two engines tandem on each shaft. Every engine installed in a submarine to-day has either six or eight working cylinders, because a proper balance cannot otherwise be secured, and it is very important to have a good balance. With the high-powered engines and high speeds of rotation used, an

unbalanced engine would cause very serious vibrations to be set up in the ship which would be unpleasant for the personnel and might loosen rivets and bolts in the ship's structure and cause serious damage.

The use of two engines tandem on each shaft introduces some more complications, but still it has one big advantage, and that is that the after engines alone can drive the ship to almost three-quarters of its full speed. It must be remembered that a warship runs at cruising speed most of the time, so that the propelling machinery must satisfy two conditions: high power for a short space of time, and moderate power with high economy for cruising for long periods of time. The four-engine arrangement meets this condition perfectly, since the cruising speed is a little over half of the full speed, and thus the after engines are under a good enough load to give good economy and yet not under severe enough stress to cause undue wear and tear on the engines.

Arrangements are such that each engine has its own reversing and control gear, and still the two on either shaft can be connected together and operated as a single unit. This is practically a necessity under war conditions. Suppose, for instance, the boat is cruising on blockade or other duty and an enemy ship is suddenly sighted. The submarine will naturally want to engage with the ship as soon as possible, and hence will desire every bit of power it has available. The boat will first be brought up to nearly its full speed under the after engine only, and in the meantime the forward engines will be started up without load, then the clutch between the two engines will be thrown in, the control gear of the engines connected together, and, finally, with both engines operating as a single unit, the boat will be pushed up to full speed. All this is only a matter of a few minutes and illustrates again one of the advantages of the Diesel engine over steam machinery—the ability to put full load on a cold engine a few minutes, or even seconds, after starting.

There are many variations in the designs of the engines

in the various boats, but the main principles are the same in all of them, and these will be explained first before going into the variations in detail.

The Diesel engine is in some ways similar to the gas engine, but there is one fundamental and very important difference, and that is that, while in the gas engine the fuel is mixed with air on its way to the cylinders, in the Diesel engine only pure air is taken into the cylinders, and the fuel is not admitted until the beginning of the working stroke, when it is time for it to burn; then it is injected in the liquid form. The gas engine uses a spark to ignite the mixture of gas and air in the cylinder, but in the Diesel engine dependence is placed upon the heat of compression. In other words, in the Diesel engine the air is compressed enough to get so hot that when the fuel is injected into this air it immediately burns.

In a four-cycle engine the sequence of events is as follows: Starting with the piston at the top of its cylinder, it moves downward on the suction stroke, drawing in pure air. At the bottom of the stroke the inlet valve closes, and as the piston moves upward on the compression stroke the air in the cylinder is compressed, and by the time the piston is at the top again the space between the top of the piston and the cylinder head is filled with air at a pressure of about 450 pounds per square inch and a temperature of about 800 to 900 degrees. The fuel valve now opens and fuel is injected into this very hot air and burns rapidly. The temperature increases, but the pressure does not. One reason for this is that the fuel is fed into the cylinder over an appreciable length of time and hence cannot burn all at once, as in a gas engine, and give an explosion. As the piston moves downward on the working stroke, the gases in the cylinder expand to within a few pounds pressure of the atmosphere. At the bottom of this stroke the exhaust valve opens, and as the piston moves upward on the next stroke the cylinder is cleared of exhaust gases and is ready to receive a fresh charge of pure air when the cycle starts over again.

In the two-cycle engine the events which took place in two revolutions in the four-cycle engine are carried out in one revolution. Here the exhaust gases pass out through ports at the bottom of the cylinder, which are uncovered by the piston, and, while these ports are still uncovered, valves in the cylinder head open and admit pure air under pressure, which clears the cylinder of all foul gases and charges it with pure air for the next working stroke. Other than this, the sequence of events in a four-cycle engine is the same as in a two-cycle engine. The pure air is compressed on the up stroke of the piston, and at the beginning of the down or working stroke the fuel is admitted. During the working stroke the fuel burns, the gases expand, and at the bottom the exhaust ports are uncovered again, the cylinder is cleared of foul gases and supplied with fresh air, and the cycle starts over again. The air for clearing the cylinder is called scavenger air, and is supplied by pumps attached directly to the engine.

Perhaps something ought to be said in regard to the character of the fuel used in these engines. It is termed fuel oil, and is the product extracted from the crude oil after the gasoline, kerosene, and such products are gone. It has a burning point of about 200 to 225 degrees Fahrenheit, which means that it must be heated to this temperature before it will burn. It can be readily understood from this that there is no ordinary danger from fire or explosion, the same as there is with gasoline and even in a degree with kerosene. Most of the fuels obtained from the western and southern section of the United States contain considerable quantities of asphaltum, but this does not in any way affect their suitability for use in the Diesel engine. The Diesel engine has even been run on vegetable oils, such as olive oil. In fact, it may almost be said that it will run on any oil that can be pumped through the piping so as to get it into the cylinders.

The Diesel engine, when working properly, burns the

fuel completely, and the exhaust is colorless and odorless. The burning of the fuel completely looks very simple on the face of it, but in reality it is something of a problem. In the first place, the time interval is very short. Submarine engines run at various revolutions, according to size and type, but 400 revolutions per minute is a fair average for the ordinary size of engine, while there are engines running at 450 and 500 revolutions per minute. These speeds do not seem high compared with those of gasoline engines in fast motor boats, but the conditions are so entirely different that no comparison can be made. On the basis of 400 revolutions per minute, and considering that the fuel valve is open about one-ninth of a revolution, the actual time the fuel valve is open is only one-sixtieth of a second. In other words, the fuel must be in such condition that when injected into the cylinder over a length of time amounting to one-sixtieth of a second it must burn as fast as admitted to the cylinder, so as to give combustion and not an explosion. This may seem like splitting hairs, but the action in the cylinder is actually one of combustion over an appreciable length of time, and it is not an explosion. In order to inject the fuel properly, compressed air supplied from an air compressor attached directly to the engine is used. Only a small amount is required, but by driving the fuel rapidly through a so-called atomizer in the fuel valve the fuel enters the cylinder in the form of a mist. Each particle of oil is a very minute sphere and presents a large surface in proportion to the volume in the sphere, so that when this mist enters the cylinder an enormous area in proportion to the quantity of oil involved is exposed to the very hot air and combustion takes place at once.

The amount of fuel actually injected into the cylinder at each stroke is very small, and yet the speed of the engine is controlled by varying this quantity. In order to accomplish this, the suction valve on the pump is timed by an independent mechanism under the control of the

engineer. If the suction valve is held open for the entire stroke of the pump, of course no fuel is pumped and the engine will stop. If the suction valve is allowed to seat at three-quarters of the stroke, then the fuel pump delivers fuel for the last quarter of the stroke and the engine runs at a corresponding speed. The mechanism is arranged so that the suction valve can be seated anywhere from about two-thirds stroke to nothing. Each cylinder has its own pump and valves, and the gear for controlling each suction valve combines into a single handle at the engineer's station, so that, whether the engine is running at half load or full load, each cylinder does its own share of the work.

When it comes to the details of the design of the engines there are many variations. Some of the engines are not only made non-reversible, but are not even made air starting. In a submarine there are very powerful motors installed for propelling the boat when submerged, and with non-air starting engines dependence is placed on the motors for manœuvring the boat on the surface and for starting purposes. In this case the starting of the engine is quite similar to starting an automobile engine with an electric starter. Sometimes the engines are fitted with starting gear only, and sometimes the engines are made air starting and reversing, so that the boat can be manœuvred under the main engines, as in the ordinary ship installation. Compressed air is used to start the engines, and this air is kept constantly stored in steel flasks ready for use. The flasks are recharged from the compressors on the engines which supply air for injecting the fuel into the cylinders.

A submarine engine must be light weight and yet be durable and reliable. In order to get this combination, advantage is taken of higher grade and more expensive materials than would be used in ordinary work, since the first cost is really a matter of secondary importance. For this reason, considerable use is made of bronze. Even the crank casings and bed-plates, pieces which weigh

several thousand pounds each, are made of this material, in order to get the advantage of strength with small weight. Aluminum is used for some of the minor parts, such as crank-case doors and covers, but it cannot be used for any important part of the engine, not only because of its lack of sufficient strength but because it has the peculiar property of disintegrating in the presence of salt water or salt air. This no doubt seems strange, in view of all the oil there is around an engine, but long experience has shown such to be the case. Special high-grade steels are used considerably for the most important steel members. Everything has to be made to the greatest exactness, the same as in automobile work, but here the parts are so much larger that the difficulties are increased considerably. The crank-shaft especially is a good example of the high grade of workmanship required. The automobile crank-shaft has four to six cranks, one for each cylinder, but it is only two, or perhaps two and one-half, inches in diameter. The big marine steam engine crank-shaft is twelve to twenty or even more inches in diameter, but it has only three or four cranks. The submarine engine crank-shaft, however, is from six to ten inches in diameter and has from seven to ten cranks, and it must be accurate in every dimension to within a few thousandths of an inch. There is far greater skill required and a higher grade of workmanship demanded in the building of submarine engines than in any other similar class of work.

There are many important details in connection with the engine auxiliaries which perhaps do not loom up very much in individual importance, but nevertheless are very necessary to the successful operation of the plant as a whole. In an ordinary ship the engine is connected directly to the shafting, but in a submarine this will not do, as when the boat is submerged it is propelled by the motors, so that there must be a clutch between the engine and the motor. When cruising on the surface the clutch is connected and the motor revolves idly, the power from

the engine being transmitted through the motor shaft to the propeller shaft. When running submerged this clutch is thrown out while the motor drives the ship. When charging the storage battery, the engine is run like a stationary engine and the motor becomes a generator. The clutch between the engine and motor is then in, but the propeller shaft is disconnected.

In the older boats all the auxiliary pumps required for the engines were attached directly to the engines, but to-day all these pumps are separate. Water for cooling the engines is supplied by centrifugal pumps which are driven by their own electric motors. These pumps take their suction from the sea, and the water, after passing through the water jackets on the engines and the mufflers, is discharged overboard. Some of the engines have their pistons cooled; sometimes this is done by an independent system of pumps which pass the cooling oil to and from the pistons through a system of pipes which telescope, one inside of the other, and sometimes a part of the lubricating oil is used for cooling purposes. All the engines nowadays have forced lubrication; that is, the oil is forced under pressure through pipes to the main bearings and then through holes in the crank-shaft and connecting rods to the other bearings. Part of the oil then continues up through passages in the piston to the head, which it cools and then drains to the crank-case. Surplus oil, including cooling oil when the pistons are cooled, drains into the bottom of the crank-case and thence to a tank. The pumps take it from here, force it through a cooler, and then to the engine, so that the same oil is used over and over again. The fuel for the engines is pumped from the tanks, which are generally in the bottom of the boat, up into small tanks in the upper part of the engine-room, and from here it flows by gravity to the fuel pumps on the engine.

The exhaust gases from each engine are carried through a pipe, which is surrounded with a water jacket, through the upper part of the hull to a muffler which is

concealed in the superstructure. In some cases the exhaust is under water, but generally it is just above the water. The cooling water from the engine generally is discharged into the exhaust gases so as to cool them and help muffle the noise. It is necessary that the exhaust be pretty thoroughly muffled, because, in case of war, it could easily betray the presence of the boat to the enemy, and the noise has a peculiarity of carrying a long distance on the surface of the water under favorable conditions, as most people know from having sometimes heard small motor boats at such a distance that they could scarcely be seen. In this exhaust pipe from the engine there is a valve fitted which must be closed tightly every time the boat submerges, in order to keep the sea-water from flooding the engine. Very elaborate precautions are taken in this regard, and drains are fitted so that, even though a little water does leak by the main valve, it will drain into the bilge of the boat and not into the engine itself.

PART V

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CHAPTER XXXIII

THE DUTIES OF THE NAVY IN PEACE

FIRST and above all the navy's duty in peace is to prepare and maintain itself in instant readiness for war. This is its highest duty, and nothing should distract its attention from that vital service.

A nation must cherish the ideals of honor and fair dealing in its intercourse with other nations. It must demand the same quality of respect for its representative citizens as it is willing to give to the citizens of foreign nations within its border. An act by a sovereign state that jeopardizes the rightful interests of another state, or aims a blow at the prestige, integrity, or manhood of another state, must be quickly resented and restitution and apology demanded. The means of intercourse between states is through diplomacy. The navy is a potent instrument of diplomacy. It has been frequently used by nations to impress upon the government of an offending state that demands made through the channels of diplomacy will receive the support of the dynamic power of the offended nation.

"A jealous regard for the dignity and honor of a state increases with the cultivation and refinement of its inhabitants and also with the increase and intimacy of its intercourse with the other civilized and enlightened nations of the world. A national insult to a country—directly or to its emblems—is not only resented by the officials of its government but by every patriotic citizen or subject at home or abroad. It is well that it should be so, for one of the strongest forces that compel an observance of the tenets of international law is that fear of censure from its fellows and of bad repute in the family of nations which now results from a deliberate violation of the law and comity of states. A sensitiveness

as to honor and dignity is as important for the states as it is for the individual. The Fijis or the Hottentots care little how the world regards them, but the opinion of civilized nations is highly valued by all those states which are now foremost in human affairs."—*C. H. Stockton.*

In countries where governments are habitually unstable, the navy has a peculiarly important function. It has the duty of affording protection to our citizens and also to promote the service of humanity.

Great Britain, in the past the greatest sea power, has used her navy to keep open all important centres of trade. Nothing must stop the free circulation of merchandise. Anything that jeopardized this circulation would find the ubiquitous British cruiser on the spot; her commander in possession of unlimited authority to remove the cause of the interruption.

Against the more progressive nations the navy cannot be used in aggressive fashion without risking a serious collision. As between them, diplomacy requires merely the slightest hint of force to bring two nations to the brink of war. As between such nations, however, the navy has been used frequently to promote friendly relations. The sending of a squadron of warships to a nation, to remain in the ports of that country, where our officers and sailors commingle with those of the other nation, has been considered the means of cementing friendship, which the changing interests of the moment seemed to indicate as desirable. In this way the navy goes as a harbinger of peace and good-will.

The navy is the nation's deep-sea police force. It has made the seas safe for our merchant vessels in a strikingly similar fashion to the city policeman patrolling the city streets.

The suppression of slave trading was accomplished by the British and American navies in coöperation. Piracy fell before the relentless pursuit of fast cruisers.

The American navy, during peace, has fought in the service of diplomacy in many parts of the world: in Japan

against pirates; in Korea, in the South Seas, notably Samoa; in several Central American countries, and, lastly, in Mexico.

In the days when our navy consisted of single vessels that cruised about from port to port in foreign lands, to safeguard American interests, when cables were seldom, if ever, used, and wireless had not been even dreamed of, our captains had need of a high order of talent in diplomacy. Much was left to a captain's discretion that is now contained in lengthy cable instructions, which practically eliminates him as a political factor in the situation. A few incidents in the experience of the writer might give some idea of the service the navy has performed in upholding our prestige and interests in different parts of the world.

The Brazilian rebellion in 1893–'94 centred almost entirely about the port of Rio Janeiro. The Brazilian navy became tired of having the presidential office habitually filled by an army general and decided to revolt—no doubt with the avowed intention of placing a navy admiral in that important office.

The navy held the waters of the great bay of Rio Janeiro. The army held the shores and the two forts commanding the narrow entrance. All traffic within the bay was stopped. The city was under siege by water.

Great Britain was most interested, for the suspension of merchant marine traffic affected a large number of steamers sailing under the British flag. The United States was affected only slightly. The war dragged on from October into April. Neither side could gain an advantage. No doubt British diplomacy exerted itself to obtain a settlement, for its citizens were heavy financial sufferers, but the United States Government was not willing to take aggressive action. In so far as we who were there know, Washington was silent. It preferred to let matters take their course.

Suddenly, without warning, our admiral ordered his ships to "clear for action" and be prepared for any

emergency at daylight the next day. There were five American ships present, among them the armored cruiser "New York." The Brazilian navy consisted of one battleship and four other vessels.

The next morning, promptly at daylight, all the American merchant schooners, loaded with flour, that had lain idly at anchor nearly six months, ran lines to the docks and began to haul themselves alongside. The American warships, cleared for action, merely watched the peaceful process of breaking the back of a lost cause. The revolution ended on the spot.

If the admiral had been a British admiral he might have been knighted or received the D. S. O., but, as a servant of a Republic, he barely missed being recalled in disgrace.

In Samoa the natives choose their king by the highly-enlightened method of the ballot. The chiefs meet and vote to decide who among them shall be king. Each chief votes as many times as custom and tradition have made his community an important or unimportant one. The counting of the ballots is a very delicate affair, and those entrusted with this duty discreetly decided a tie vote. The Samoa law provided under such circumstances that the Chief Justice of the islands, who was an American, should decide the tie.

It should be understood that Samoa at this time (1899) was administered by a Commission of three Consuls, one from England, one from Germany, and one from America; the Chief Justice of the islands was an American, and the referee. The Chief Justice disqualified one candidate because one of the countries interested had said in diplomatic correspondence, ten years before, that it would never consent that he should be king. During the interim, however, that country had changed its policy, and now he was its choice.

The consequence was rebellion. The Americans and English openly supported the selection of the Chief Justice; Germany held off, but threatened by implication.

Fighting occurred. English and American lives were lost. Feelings ran high. A spark might have touched off the powder magazine.

The American admiral was recalled. A Commission was sent to Samoa. Through its meetings a peace was patched up and the islands divided up. We obtained the island of Tutuila, with the only safe harbor. The English naval officer in command was promoted for his services.

In Shanghai, during the Japanese-Russian war, the American Asiatic fleet were collected. After the battle of August 10th, the Russian cruiser "Askold" and a destroyer sought safety in that Chinese port.

Japan sent a squadron to the entrance of the Yangtse River and a destroyer to Wusung, where the American ships lay anchored, to demand from the Chinese authorities that the Russian ships be immediately disarmed or forced to put to sea. It was said that a threat was made to violate the neutrality of the port if the demand was not granted in twenty-four hours.

Shanghai is an international city, lying at arm's length to a walled Chinese city of the same name, with a population of over a million souls. The Russian ships, as yet not interned and apparently expecting and ready to repulse an attack, were tied up to docks within a stone's throw of our Standard Oil Works, where there were tanks containing thousands of gallons of oil and gasoline.

There was no time to receive instructions from Washington.

The American admiral prepared his ships for service, and stationed them in evidently good tactical positions to be able to remain master of the situation. No word passed between him and the Japanese admiral outside. A Japanese destroyer entered and reconnoitred; apparently satisfied, it returned to the entrance to report. The Russian admiral, having saved his face, quietly agreed to disarm. The Japanese squadron sailed away.

These are some of the situations our naval officers

have had to face in the past and will have to face again. They may have to make decisions the outcome of which may make or break them.

The navy has been the means of charting many treacherous coast lines and outlying dangers. Almost the entire coast of Mexico was surveyed by naval vessels, and all the coasts of Alaska yet surveyed. Lately this duty has been taken from the navy and put under the Treasury Department.

The light and buoy system of the country is the navy's work.

The rapid growth of warships, requiring a large personnel to adequately man them, has resulted in relieving the navy of many incidental duties which in less strenuous days there was time enough to undertake.

An important duty for the navy, in peace, is the education of the country as to America's need for a strong and efficient navy, and to give to the people a concrete and complete picture of what the navy is and does. This can be accomplished by frequent visits of our warships to our less-visited American ports, and by carefully-thought-out and non-partisan exposition of the fundamentals of naval service either through conversation, lectures, or in print.

A further and even more important duty of the navy is the training of its reserve.

CHAPTER XXXIV

THE SAILOR AS A SOLDIER

A WARSHIP may be required to exert force on land beyond the range of its guns, and must be prepared for this work. Even under the guns of the ship, it may be necessary to send ashore an armed force. There have been frequent occasions where this service has been demanded of the navy. The most recent example was at Vera Cruz, where the crews from our battleships, reinforced by a regiment of marines, landed under the guns of the warships and captured that Mexican city at the sudden order from the Washington Government.

The warship's primary duty is to fight its men afloat; they are trained more especially for this purpose. To land sailors to fight as infantrymen or artillerymen is to employ them on service for which they can be only partially prepared. Many naval officers have urged that the sailor should never be landed, that their value on warships was too great to risk in work for which they are so illy fitted.

However well taken is the principle that a sailor should be required to fight only afloat, conditions often arise forcing the violation of the principle, and for this reason it is necessary for the navy to be as well trained for land service as its time permits.

The navy has a large force of men trained especially for fighting ashore. The Marine Corps of our navy consists of 648 officers and 14,981 enlisted men, peace strength. They are organized into brigades and regiments. Special transports manned by the navy are maintained to carry these soldier-sailors to whatever point should be required. The marine corps training is principally for soldier duty, both infantry and artillery, but each officer and man is required to serve at sea in war-

ships in addition. Each battleship carries a guard of marines, consisting of two officers and about seventy-odd men. The marines are available for landing under the command of the fleet marine officer, usually a colonel. The marines afloat are but a part of the total of the corps.

The marine corps is a separate branch of the navy, bearing the same relation to the rest of the navy as the artillery bears to the rest of the army. The marine corps has its own organization, obtains its money from Congress separately, and has its own staff, supply, and pay departments. At the head of the marine corps is a major general of marines. Each brigade is commanded by a brigadier general and each regiment by a colonel.

The training of the marine corps is similar to that of infantry of the army, with the exception that it is more comprehensive. Marines are expected to use not only the rifle and the machine gun, but also light artillery. The marines form the garrison at naval advance bases and prepare the base for defense. They are expected to mount guns in the defense, to lay mines for protection of the harbor, and man all the weapons of defense installed.

While forming a part of the crew of a warship, they may be stationed at any gun except guns in turrets. They may form the crews of 7-inch, 6-inch or less calibre guns. As a rule, they man a part of the torpedo defense battery. Their stations are such that when the marines are absent the service of the battery will not be seriously affected.

In the event of an act of semi-hostilities short of war, requiring, say, several thousand trained soldiers at short notice, the marine corps is called into use for the purpose. Five thousand marines can be started on an expedition inside of twenty-four hours. They would be carried in their own transports or on board of warships. The efficiency of the marine corps is high and their usefulness to the navy and the country is great. The marine corps equipment is thorough, and when serving with the navy they can be supplied from naval ships with-

out troublesome questions with the Treasury Department, likely to occur where army men are so supplied. Furthermore, marines can be sent to a foreign soil without any legal questions arising, while to send an equal number of soldiers the questions of war and invasion at once arise.

It was a peculiar situation for the army to have an expeditionary force several hundred miles in the interior of Mexico. The Judge Advocate General of the Army, in order to legalize military courts constituted for punishment of offenders, was forced to decide that the United States was at war with Mexico, creating, doubtless, much embarrassment to our diplomats. If this force had been marines no such decision would have been necessary. United States marines have been doing police-work in the unstable Latin-American countries for years, and no mention of war has ever been made.

In order, then, to be able to land an armed force from a warship, organization for this duty is necessary. In the regulations it is expressly stipulated that not more than one-half of the combatant force shall be landed at any one time.

Each ship must have a permanently organized landing force composed of infantry and artillery. The ship landing forces are units forming the squadron landing force. A squadron of eight ships would have a landing force of sixteen to twenty companies, including artillery companies.

The organization follows that of the infantry: squads, sections, companies, battalions, regiments, and brigades.

Battalions, regiments, and brigades are furnished staffs commensurate with the duty to be performed.

A regimental staff consists of adjutant, quartermaster, ordnance officer, commissary, surgeon, signal officer, and two aides.

A battalion staff consists of adjutant, commissary and surgeon.

It is not contemplated that a naval landing force will have to go into the interior of a hostile country. Its

principal duty will be to establish order ashore close to the sea and in supporting distance of the warships. Supplies of ammunition, clothing, and food, taken, will be the minimum for the work required. The warships will furnish a base of supplies and communication between the landing force and the warships must always be kept open.

Such a landing force must comprise, besides those forming infantry and artillery, many special classes of skilled work; those men who perform work other than the fighting and policing are called special details. They consist of pioneers, signalmen, messmen, ammunition and ordnance party, gun cotton party and ambulance party.

Duties of the men in the special detail:

Pioneers.—Field fortification construction, bridge building and work such as would be performed by engineers in the army.

Signalmen.—Flag signalling, heliograph, searchlight signalling, telegraph, radio (wireless). They perform the duties performed by the signal corps of the army.

Messmen.—Perform the duty performed by the commissary of the army—one messman is detailed for each section landed. Provides and prepares food for his section.

Ammunition and Ordnance Party.—Composed of gunners' mates; carry spare parts for small arms and field pieces and the necessary tools for repairs to same; cares for and transports reserve ammunition.

Gun Cotton Party.—Provided with gun cotton or other high explosive for blowing up fortifications, buildings, bridges, destroying guns or planting land mines.

Ambulance Party.—Performs the same duty as hospital corps of army.

Besides the above special details, electricians, locomotive engineers, and other special trades frequently found among the enlisted force on board ship are attached to *the landing* force.

The landing force is landed in ship's boats. The flotilla of boats is commanded by an officer acting as beach-master. He has with him sufficient armed men to protect the boats on the beach from attack in the absence of the landing force from the immediate vicinity; also to care for the boats and protect them from weather or sea. In case the ships are in the harbor or near at hand, the boats may return to their respective ships.

To a landing force *transportation* is a matter of the most vital importance. Before landing or immediately afterwards all possible steps should be taken to seize locomotives, cars, wagons, auto-trucks, draft animals and even automobiles and carriages. Native laborers should be hired or pressed into service.

Arms.—Officers carry automatic pistols—competent petty officers and special details carry the pistol. All enlisted men and petty officers in the infantry sections are armed with the rifle. Ambulance party carry no arms but wear the Geneva Cross on the left arm. Boat keepers carry rifles.

As a rule attached to each battalion landed are two machine guns and a 3-inch field piece. The field pieces are usually organized into a battery. The artillery sections carry rifles except the first petty officer and numbers one to four who serve the gun and are armed with pistols.

Boiled water only will be used unless the supply is obtained from on board ship.

A full description of officers' and men's equipment for the landing force will be found in "The Landing Force and Small-arm Instructions, United States Navy, 1916."

CHAPTER XXXV

THE NAVAL RESERVE

THE following are the *computed numbers,* or "authorized strength," of the Navy—officers and enlisted men, midshipmen, Flying Corps, etc.—allowed under the Act of Congress approved August 29, 1916, for the current half of the calendar year 1916, upon which computed numbers are further computed the *fixed numbers,* or "authorized strength," of the various grades and ranks for the current half of the calendar year 1916. Computations all made subsequent to August 29, 1916, "as of" July 1, 1916.

Computed Numbers of Line, Staff, and Warrant Officers, Enlisted Men, Midshipmen, Etc., for Current Half of Calendar Year 1916.		"Authorized Strength" of Various Grades and Ranks for Current Half of Calendar Year 1916, Based on Total Computed Numbers.	
Enlisted men proper	a68,700		
Apprentice-seamen	a6,000		
Hospital Corps (including chief pharmacist and pharmacists)	a2,929		
Enlisted men sentenced to discharge	b2,034		
Enlisted men detailed to Naval Militia	b1,309		
Enlisted men of Flying Corps	a350		
Line	c2,086	Rear Admirals (upper half; lower half)	21
		Captains	80
		Commanders	146
		Lieutenant Commanders	292
		Lieutenants	678
		Lieutenants, junior grade; Ensigns	869
			2,086
Medical	c362	Medical Directors, Rear Admiral (upper half; lower half)	2
		Medical Directors, Captains	15
		Medical Inspectors, Commanders	26
		Surgeons, Passed Assistant Surgeons, Assistant Surgeons (Lieut. Comdr., Lieutenant, Lieut., jr. grade)	319
			362

Computed Numbers of Line, Staff, and Warrant Officers, Enlisted Men, Midshipmen, Etc., for Current Half of Calendar Year 1916.		"Authorized Strength" of Various Grades and Ranks for Current Half of Calendar Year 1916, Based on Total Computed Numbers.		
Pay	c234	Pay Director, Rear Admiral	upper half lower half	1
		Pay Directors, Captain		13
		Pay Inspectors, Commanders		18
		Paymasters Passed Assistant Paymasters Assistant Paymasters	Lieut. Comdr. Lieutenant Lieut., jr. grade Ensign	202
				234
Construction	c94	Naval Constructor, Rear Admiral	upper half lower half	1
		Naval Constructors, Captain		7
		Naval Constructors, Commander		11
		Naval Constructors Assistant Naval Constructors	Lieut. Comdr. Lieutenant Lieut., jr. grade	75
				94
Civil Engineer	c44	Civil Engineer, Rear Admiral	upper half lower half	1
		Civil Engineers, Captain		2
		Civil Engineers, Commander		5
		Civil Engineers Assistant Civil Engineers	Lieut. Comdr. Lieutenant Lieut., jr. grade	36
				44
Chaplains	c84	Chaplains	Captain	8
			Commander	17
			Lieutenant Commander	17
			Lieutenant Lieutenant, junior grade	42
				84
Professors of Mathematics	d12	Professors	Captain	3
			Commander	4
			Lieutenant Commander Lieutenant	5
				[illegible]

Computed Numbers of Line, Staff, and Warrant Officers, Enlisted Men, Midshipmen, Etc., for Current Half of Calendar Year 1916.		"Authorized Strength" of Various Grades and Ranks for Current Half of Calendar Year 1916, Based on Total Computed Numbers.	
Dental Corps.......	a84	Dental Surgeons..	Lieutenant Commander... Lieutenant............... Lieutenant, junior grade...
Midshipmen.......	a1,762		
Flying Corps (officers)............	a150		
Chief warrant officers.............	b502		
Warrant officers....	b362		
Chief pay clerks, pay clerks, and acting pay clerks.........	c325		
Marine Corps (officers, line, staff, and warrant), 637; additional numbers in grade, 3; clerks to assistant paymasters, 9...........	649		
Marine enlisted men proper (including 67 members of band)...........	a14,981		
Marine, enlisted men sentenced to discharge...........	b505		

a Number "fixed" permanently—does not change under existing law.
b Number "fixed" temporarily—for date of July 1, 1916—fluctuates from day to day.
c Number "fixed" temporarily—does not change until new computations are made for the succeeding half calendar year.
d Number "fixed" permanently—but corps will die out with passing of present members from the active list.

In the event of war with a first-class naval power, our navy will require no less than 225,000 men. They must be trained men, for the demands of war will not give time nor opportunity to conduct training; and the result of manning warships with untrained men is too terrible to contemplate. How shall we obtain these trained sailors? The enlisted personnel of the navy if recruited to full strength allowed will give us about 75,000 men, or one-third of the number adjudged necessary in war. We then must obtain 150,000 naval reserves and set to training them immediately.

The old naval militia, kept up by the several states,

would supply perhaps 10,000 men—many of these are not seafaring men, but have knowledge of technical trades useful in the navy. They have had sufficient training to make them useful, and if drafted and mixed in with well-trained and seasoned sailors will be helpful, especially on board vessels to be used primarily for defensive purposes.

It has been estimated that our seafaring class will recruit us in time of war about 40,000 men. Still, we would lack 100,000 of the number required. These would have to be drawn from the non-seafaring class of our citizens.

The average citizen looks upon the life of a sailor and especally that of a man-of-wars-man as one of hardships, privations, restrictions and dangers. He surrounds these with mystery, for he does not understand machinery, great guns, torpedoes, submarines, mines, navigation, storms, fogs, collisions and the hundred other "things" that are familiar to a sailor.

The patriotic citizen is willing enough to risk life and limb and endure hardships, but he prefers to take the risks and endure the hardships among dangers he can comprehend. For these reasons the army is always more popular in war than the navy. It is, therefore, the navy's duty in peace to dispel these mysteries and insure that the necessary number of naval reserve will be ready to answer the summons in war.

The army in times of national emergency might have some trouble to enlist 2,000,000 men. It could not equip them. The navy would have still more difficulty in enlisting 100,000. Yet the latter are needed first, for unless our war is with England, who could attack us through Canada, the invading army must come by water.

It is fundamental that with an adequate navy fully equipped and manned with 225,000 trained men, no power would be likely to attempt, by sea, the invasion of our soil. The force required by an enemy would be so enormous and expensive to fit out and maintain that the results

expected would not warrant the terrible risks to be taken. Transports loaded down with troops are legitimate prey for the submarine and we shall have large numbers of efficient types of this craft in the future. On the other hand, if our weakness in trained men is known by our enemy, then he may discount the risk, for untrained sailors are far worse than untrained soldiers, and it takes much longer to train the sailor.

By the volunteer system, no account is taken of the individual's special fitness. He is simply a soldier and shoulders a rifle. Of course a certain amount of distribution is necessary. Infantry, cavalry, artillery, signal corps, etc.

In mustering into the army 2,000,000 men, probably 100,000 or more of these have professions and trades which would make them particularly valuable to the navy and their places could be filled with others.

To understand this we must remember that "sailoring" is a very small part of the sailorman's profession, yet it is the crowning attribute—a navy without *sailors* is doomed to defeat. Sailors actually operate the ship as a whole and wield the great weapon, the fleet, in a tireless search to bring the enemy to battle.

The professions and trades required in the navy embrace the entire gamut of those useful ashore—doctors, accountants, clerks, stenographers, machinists, pharmacists, cooks, nurses, caterers, waiters, blacksmiths, electricians, telegraph and radio operators, painters, firemen, bakers, water tenders, plumbers, carpenters, moulders, tailors, barbers, mechanics; in fact, skilled men of every kind are required at the navy yards in the industrial plants and on board the ships of the fleet.

Thus many men can find employment in the navy, where they will be called upon to perform the duties pertaining to their own trades for nine-tenths of the time. During the other one-tenth of the time they can be learning to take care of themselves, their outfits, and perform *those duties* essential to the safety of the ship, yet which

require no nautical knowledge. The purely nautical part of the work can be done by the 50,000 to be obtained from the naval militia and our sea-going population.

If the navy has but 75,000 trained men on the outbreak of war, one-third of these would have to go to man the naval auxiliary forces, leaving but 50,000 for the battle fleet proper. During the Spanish War one-third, approximately, of our trained force served on board colliers, tugs, coast defence vessels, patrol vessels, revenue cutters, lighthouse tenders, receiving ships, recruiting stations, training stations, etc. These 50,000 must leaven the total mass of men required to man every available warship which would be hastily recruited to full complement. This would put upon the trained navy an added hardship at a time when all would be under great press of work.

If one stops to consider that if, in time of peace, we could familiarize in the naval mysteries 100,000 nonseafaring men and depend upon this total enlisting in the navy instead of the army in time of war, then each of this 100,000 would be worth to the country twenty times more than if he had enlisted in the army, for if the navy is adequate, the 2,000,000 of the army may not be jeopardized. These 100,000 will give to their country the full benefit of their years of training at their trades, which they could not do in the army, for many of these trades are not required; at least, not in such vast numbers as in the navy.

To carry this idea to its logical conclusion, we should endeavor in time of peace to organize our resources in skilled men so that we may have at least 100,000 men skilled in the necessary trades and arts, sufficiently familiar with the navy and naval life to be willing, not to say eager, to serve afloat in time of war. These men should be given sufficient training on board war vessels of the latest type in order to know at least the essentials of a "man-of-warsman's" life and duties. He should be taught where and how to eat, sleep, bathe and supply his own needs, receive instruction, obtain information

and of course perform the duties of the particular trade for which he would be required in time of war.

Appreciating the vital necessity of creating an adequate naval reserve force, the last Congress passed legislation giving something upon which to build. Space is too limited to go deep into details of this legislation, but an outline will be attempted:

General Classes of Naval Reserve Force:

Class 1.—Fleet Naval Reserve (ex-service officers and men).

Class 2.—Naval Reserve (seafaring Americans).

Class 3.—Naval Auxiliary Reserve (Americans employed on board vessels which are listed for war auxiliaries).

Class 4.—Coast Defence Reserve (Americans who will be employed in coast defence).

Class 5.—Naval Reserve Flying Corps (American aviators or mechanics).

Class 6.—Volunteer Naval Reserve (any of above serving without pay).

General Requirements:

Class 1.—Honorably discharged men from the navy. They must serve three months on active duty each four-year enlistment. They may enter in *rate* last held. The following is annual retainer pay:

(*a*) Men having served one enlistment.... $50.00
(*b*) Men having served two enlistments.... 72.00
(*c*) Men having served three enlistments.. 100.00

Men who have served 16 years in the navy may be transferred to the reserve and receive one-third their base pay plus all permanent additions. Men who have served 20 or more years may be transferred to reserve and receive one-half their base pay, plus all permanent additions.

Active service is, when practical, undergone at reservist's convenience. Full pay is given on active service in *addition to* the retainer pay.

In the fleet reserve each enlistment carries with it a uniform gratuity of $30 and the base pay is increased 25 per cent.

Officers.—Graduates of Naval Academy who have honorably left the service, enroll with rank last held in the navy or may qualify by examination for higher rank, but not above that of Lieutenant Commander. Deck or engineering duties are optional. They are required to serve three months on active duty each four years. Their pay is two months' active pay each year and a uniform gratuity of $50 each four years. On active service they receive full pay of grade held.

Class 2.—Composed of American citizens of seagoing professions, between the ages of 18 and 35 years. They enroll for four years. Three months' active service required in four years.

Retainer pay: Two months' pay of rank or rating held. Full pay on active service. Men of this class must have had two years' experience on board ocean or lake vessels. Their pay increases 25 per cent. upon each enlistment.

Class 3.—Composed of American citizens serving on board vessels listed by the Navy Department as desirable naval auxiliaries in the time of war. No active service in the navy is required. Examination for rank or rating is limited to merchant service requirements. In time of war will serve on merchant auxiliaries only. The pay allowed is: men two months' pay of rating in navy; officers, one month's pay of rank in navy; pay increases 25 per cent. for each enlistment.

Class 4.—Composed of American citizens used in coast defense, not necessarily at sea. Required to serve in power boats, as radio operators afloat or ashore, extra guards, etc. All requirements and pay same as Class 2.

Class 5.—Composed of American citizens who are aviators, aeroplane designers, builders or mechanics. Requirements and pay same as Class 2.

Class 6.—Composed of men of Classes 1 to 5, serving without pay.

General.—Pay is given quarterly. No pay for less than three months' service. Where active service is required reservists get $12 a year only until they have served three months' active duty, when they may receive their full retainer pay.

After 20 years in reserve, a member may sever his connection and will receive a gratuity of four years' reserve pay instead of pension.

In active service all members of reserve are upon same footing for pay, pensions, etc., as those men of the regular service and receive retainer pay in addition.

Administration:

Class 1.—Reservists of this class come under the Reserve Office of the Bureau of Navigation. Recruiting officers are in command of reservists in their districts.

Classes 2, 3 and 4.—Under the Commandants of Naval Defense Districts.

Class 5.—Under the Commandant of the Aeronautic Station.

Class 6.—Are among the above classes.

In general, the Fleet Naval Reserve is composed entirely of ex-service men and officers. They will be men of proven merit in the regular service. It is quite essential that all members of this class keep in close touch with the developments of the navy, such as changes in gunnery or engineering, or whatever their specialty may be, as well as changes in general methods and organization on board ship. It is considered putting all this class on a mailing list for the receipt of educational publications.

Class 2 of the Naval Reserve Force is to be composed of American citizens of seagoing professions, between the ages of 18 and 35 years. It may not be clear to those interested as to the exact meaning of the phrase "seagoing professions." It must be remembered the "sailoring" in these modern days calls for many professions that originally were considered as particularly identified with the land. To make this clear, the following explanation shows the basic needs of our fleet in war:

(*a*) It has been shown that in time of national emergency the fleet will require great increases in personnel, to fully man all ships ready materially for service.

(*b*) There will be required in addition officers and men in all ranks and ratings to be trained completely to man vessels of war completing construction and besides to fill vacancies in the fleet itself caused by casualties in battle and casualties due to sickness. Besides officers and men will be required to increase the personnel at the navy yards, naval stations and to inspect the vast amount of material and new construction ordered by the government in consequence of the war.

(*c*) In time of strained diplomatic relations and when war has actually begun the industrial activities of the country, especially those capable of producing war material will be vastly intensified and will require many more men than are employed normally in time of peace. This self-evident fact must be borne in mind in order that enrollment in the Naval Reserve Force will not jeopardize the most necessary work of the production of the sinews of war.

(*d*) In industrial life, especially in our great cities, are a large number of able-bodied men who are proficient in trades used on board the several classes of warships. Their special knowledge is not enough; they must be given in addition, in order to be useful, sufficient training on board ships to acquire the principles of naval discipline in order that they may have the facility to fit into a ship's organization and there perform similar work to that they are accustomed to perform on shore. These men simply require orientation to be as efficient on board ship as they have been in their special trades ashore.

(*e*) Some method must be devised through appropriate organization under the Personnel Bureau—the Bureau of Navigation—to codify, classify and organize the trades that will be needed in time of war, in the fleet, in the industrial centres, at navy yards and naval stations. The purpose being to fully meet the demands of the fleet

in personnel and also to continuously and amply provide the necessary war material, construction and repair to carry on an aggressive campaign at sea against the enemy.

(*f*) In order to give this required and essential orientation to the men having trades useful to the naval profession a definite period of actual contact with naval life must be provided. This will enable them to embark, when the call comes, on their new duties afloat smoothly and with minimum embarrassment and friction. This is to be accomplished by enrolment into the Naval Reserves, Class 2, and making necessary three months' active service in four years.

The following industrial trades are needed in the complements of warships:

Steam Machinery, Reciprocating and Turbines.—Engineers, machinists, oilers, boilermakers, water tenders, blacksmiths, coppersmiths, firemen and coal passers.

Machinery, Gas and Oil Engines.—Engineers, machinists.

Electrical, Dynamos and Motors.—Machinists, electricians, linemen.

Electrical, Storage Battery.—Electricians.

Electrical, Gyro Compass.—Electricians.

Electrical, Radio.—Electricians, Operators.

Ordnance, Guns.—Machinists.

Ordnance, Torpedoes.—Machinists.

Ordnance, Mines.—Machinists.

Ordnance, Explosives.—Powder workers, Shell loaders, Fuse makers.

Hull Repairs.—Steel workers, Carpenters, shipwrights, shipfitters, riggers, blacksmiths, machinists, pipefitters, etc.

Draughting.—Draughtsmen.

Commissary.—Caterers, stewards, cooks, bakers.

Clerical.—Stenographers, clerks, storemen.

Medical.—Doctors, dentists, pharmacists, nurses (male and female).

These industrial trades will be found in the industrial

organizations of our large cities, such as engine builders, locomotive works, power plants, ship yards, boiler works, electric companies, storage battery companies, structural steel companies, railroads, trolley companies, gun manufacturers, torpedo manufacturers, gyro compass manufacturers, mine manufacturers, powder works, hotels and restaurants, civil hospitals, etc., and also on board merchant vessels under our flag.

In addition to these industrial trades that find employment both ashore and afloat, there is the trade of the true sailor. These special men will be found in our merchant marine, more especially among our coasting trade and on the Great Lakes. They will be expert mariners, quartermasters, helmsmen, pilots, skilful navigators, under officers, boatswains, leading men, boat steerers, sailmakers and just plain sailors. These men will require training on warships not for the purpose of their profession of the sea, but in order to get the naval essentials and be brought under the discipline of the service. Many of these professions will be in demand during war, for our coasting trade may not be stopped, provided the fleet is capable of giving it ample protection, but the fleet must be considered first and its wants promptly filled.

To have a Naval Reserve of such specialists as listed above will be a mighty power for the nation.

Class 3 is composed of American citizens serving on vessels listed by the Navy Department as desirable naval auxiliaries in time of war. No action service is required of this class and in time of war it will serve on merchant auxiliaries only. Having this Reserve will strengthen the fleet, for without such a reserve the personnel must be reduced to furnish crews for its auxiliaries.

In war there will be required a great number of small vessels, to be used for various war services: patrols, mine layers, mine sweepers, net layers, inshore scouts, submarine chasers, torpedo boats, etc. Many of the vessels existing will be listed and their crews enrolled in Class 4 of the naval reserve force. There will be citizens,

however, who will voluntarily build boats at their own expense, suitable for war purposes and enroll crews to man them. These men are to be encouraged and are classified in Class 6, serving without pay. They are made a part of the naval reserve force and are organized and attached to Naval Defense Districts. The government, through the Navy Department, guides them and gives them a classification. Once a year these vessels should be mobilized and trained in their probable duties.

The other classes are self explanatory.

Active Duty of Naval Reserve Force:

It is axiomatic that nothing can be done well that has not been carefully planned in advance. Planning requires both time and facilities for the work.

It is supposed that the active duty of the reserve force will be made on board ships of what is called the second line, or the reserve fleet. These vessels will be least inconvenienced in their war training and it appears to be a very excellent service for them to be on. However, only the most modern vessels of this fleet should be used. A limited number of the naval reserve force could be assigned to the active fleet. It would be best to make the selection at the end of the cruise for the coming year; those who show the most aptitude to be given preferment.

The naval reserve squadron should consist of battleships, cruisers and destroyers.

The vessels designated for the training of the naval reserve force should be selected several months in advance. The complements of the ships selected should be carefully picked, officers and men. The number should not be less than 60 per cent. of full complements. This permits 40 per cent. of the complement in reserve force, officers and men.

The ships designated should be organized into a squadron for this special service and should be permitted to leave the navy yards and cruise for one month singly. After one month of shaking down, then one month of *squadron* training should follow. Under no circumstances

should the personnel of these vessels be disturbed. At the end of the second month, the time of beginning of the reserve force cruise having arrived, ships should proceed to the most convenient localities for embarkation of the reserve force.

The Commander of the Squadron should prepare a detailed and systematized plan for the active cruise. Much of the time should be spent on drill grounds; only the latter part of the cruise should be at sea in manœuvres. The idea must be to progressively train the reserve force personnel; to stimulate their interest and broaden their horizon by progressive step by step training from the simplest to the complex and finally to reach a climax giving these men an idea of what may be expected actually in war.

Those who have never been subject to military and naval discipline must realize in advance that for men of mature age, having always been free to indulge themselves with every desire within their limitations, unused to living in a restricted space and sharing their life with hundreds of other men, unaccustomed to living by the clock, that is rising at a definite hour, doing their work at prescribed times, eating at a fixed hour and retiring at a fixed hour, the life they are about to live on board ship for several weeks or months is bound to put a severe tax upon their patience, temper and even their endurance.

In the first place, it must be impressed upon the volunteer that an enlisted man has only a canvas bag in which to stow his clothes, that he must sleep in a canvas hammock swung between hooks on a crowded, yet well ventilated, deck; that he must lash his own hammock in the morning, stow it in the place provided, called the nettings, and get it again when hammocks are piped down in the evening, about 8.20 P.M., and that he must then unlash it for sleeping and be "turned in" it at 9.00 P.M.

The sailors, as well as the men of the naval reserve force, must be prompt at each meal when the call is sounded, for only a limited time is allowed at meals.

Promptness and punctuality is a requisite of discipline. The enlisted man can have access to his bag, in which his clothes are stowed, only at certain stipulated times.

He is allowed only one bucket of fresh water a day, or maybe two, and must not be wasteful of this water. He must scrub his own clothes and hang them himself on the clothes line and get them himself when the clothes are piped down.

He must provide himself with a full kit of uniform, blankets and pillow, underclothes, socks, shoes. Rain clothing is probably optional, but as the space on board ship for stowing such articles is limited it is better that the reserve not supply this particular clothing but depend upon the ship to furnish them if called upon for duty in inclement weather.

The enlisted men of the reserve are under regular navy discipline from the moment of enrolment. Naturally enough the very rawest recruit will not be as severely disciplined for infraction as would trained men, who should know better, yet each offense carries with it some measure of punishment. Ignorance is always accepted as an excuse if clearly shown to be a valid excuse. The idea of punishment is to bring the offender to his senses. Those who err through ignorance and are penitent require nothing more than instruction and a warning.

It would be highly advantageous if the reserve could be sent first to training stations or training camps, where they could be given a week to ten days of elementary instruction and training. The ship is not fitted, due to cramped space, for the ground work of teaching men how to care for themselves and their belongings. Men when brought together in crowds lose much of their personal characteristics. They are influenced psychologically in a very strange manner and become in some cases almost as helpless as so many undeveloped boys. At the training stations or camps, their outfits should be completed and clothes marked plainly and in accordance with instructions. Their special aptitude should be dis-

covered and their preferences for duty inquired into in case they have been trained in no special trade.

During the above period the reserve should be carefully instructed in just what to expect when they join their ships. The naval officers detailed for the instruction in these camps should be required to prepare in advance an itinerary or schedule of employment, and it should be thorough for every minute of the time. These schedules should be standardized by the Navy Department.

When the reserves leave the training station or camp, to go on board ship, they should be organized into groups with group leaders—each detail for a ship should be in charge of a regular naval officer, and with the correct number of reserve officers and men to complete the allowed full complement of their ship. For instance, suppose one group is to go to the Rhode Island class of ship. Crew of 30 officers and 900 men. Then the detail of reserves to that group would be 12 officers and 360 men. The ratings should be fixed in so far as possible in the following manner: a complement sheet should be sent to the training station or camp by the ship, showing the ratings required to fill the complement; with this data but little difficulty should be found in making the details. Of course, many of the men will be given ratings which they may not be able to "hold down," as the sailor would say, yet each man would know what he was to do and many would be prepared to do it.

The object of the training of a naval reserve force is to ground the man in the fundamentals of naval life afloat, in order that in time of war intelligent men of some naval experience would be willing to enlist in the navy and to do work for which his shore training has fitted him. These men with technical trades useful in the navy, being of superior education and character, would soon become accustomed to the more or less unnatural or at least untried life on ship board.

CHAPTER XXXVI

FIRST AID AND HYGIENE

BY RALPH WALKER M'DOWELL, M.D., PASSED ASSISTANT SURGEON, U. S. NAVY

First aid is emergency treatment to one injured or suddenly ill, until he can be placed under the care of a physician.

Every officer and man in the naval service should be capable of rendering first aid, for the services of a medical officer might not be instantly available in an emergency, and the fate of an injured man would rest with those present at the time of the accident. The resuscitation of a person apparently drowned, the control of hemorrhage, or the prompt application of a first-aid dressing might save a life pending the arrival of a medical officer. On board ship divisional officers are instructed in first aid by the medical officer. The divisional officers instruct their men.

"At general quarters and at special exercises with the approval of the commanding officer, the medical officer shall distribute a sufficient number of first-aid appliances for all requirements and frequently advise divisional officers as to the use of these appliances, as provided for in Article I, 2641."—U. S. N. I. 2109.

Article 2641, United States Naval Instructions, which is referred to above, is as follows:

"In order that all men in the naval service may be properly drilled in first aid, instruction therein shall be given by divisional officers to the men under their immediate command. The periods for such instruction shall be of ten minutes' duration twice a week, when practicable, to follow or form part of the exercises of a regular drill period, and shall be limited to the following subjects: (*a*) Control of hemorrhage (*b*) application of occlusive

dressings; (*c*) resuscitation of the apparently drowned. The Bureau of Medicine and Surgery will issue detailed information covering the above points. The necessary dummy dressings shall be supplied by the medical department of the ship or station. Divisional officers shall be instructed by the medical officers of their respective commands in the details of first-aid drills as may be necessary."

FIRST-AID MATERIALS AND THEIR USE

Bandages.—Bandages are made of gauze, muslin, and flannel. They are used to retain dressings, to control hemorrhage, to support injured limbs, to hold splints in position, and act as slings. For first aid the two kinds of bandages used are the roller and the triangular. A bandage should be applied firmly but not so tightly as to interfere with the circulation of the blood. When bandaging the hand and arm, or the foot and leg, a portion of a finger or toe should be left exposed, if possible, for by examining the exposed member one can get an indication of the condition of the circulation in the bandaged extremity. To become proficient in the use of the roller bandage one should get instruction in the application of the spiral, the spiral reverse, and the figure of eight bandages. The triangular bandage is a good substitute for the roller bandage, is more easily and quickly applied, can be made from material which can be procured without difficulty, and is not likely to stop the circulation by reason of being applied too tightly by an inexperienced person. It can be quickly made from a handkerchief, sheet, pillow case, napkin, shirt, skirt, or piece of unbleached muslin. The size depends upon the part of the body to which it is to be applied, but in general a cloth 36 inches square, folded diagonally, is proper.

First-aid Packet.—The first-aid packet of the United States Navy is a small tin package containing two sterilized first-aid dressings, each wrapped in waxed paper, and two safety pins. The first-aid dressing consists of

a gauze compress sewed to the middle of a gauze bandage sixty inches long. The compress is a double thickness of gauze 16 inches square and folded several times. It can be unfolded according to the size of the wound. These packets are distributed to gun crews in turrets and to men in expeditionary forces.

Tourniquets.—A tourniquet is used to stop bleeding from an injured artery. An elastic rubber tube is the standard military tourniquet, but in an emergency an improvised one can be made of a strap, suspenders, handkerchief, necktie or bandage. A loose turn is taken around the limb above the bleeding point and tied in a reef knot. A small stick or lead pencil is then passed under the turn and it is twisted until the slack is taken up and the pressure is applied. Sufficient pressure should be applied to control the hemorrhage. This improvised tourniquet is called a " Spanish windlass." A tourniquet should not be left on longer than a half hour, because of the danger of gangrene.

Splints.—Splints are supports to prevent motion of broken bones. They are made of boards, cardboard, or wire netting, and padded on the inner side. Improvised splints can be made from any stiff or rigid material such as rifles, bayonets, broom handles, umbrellas, canes, fence boards, barrel staves, branches of trees, or book covers. A pillow or a folded article of clothing bandaged around a fractured leg makes a splendid emergency splint. Care should be used in the application of a splint that there is no unnecessary movement of the broken bone, that it is not bandaged too tightly, and that the broken bone is immobilized.

Compresses.—Compresses, or pads, are made of sterilized gauze, and applied to open wounds. The unsterilized hand should not come in contact with the wound, or that portion of the compress which is to be placed on the wound.

Stimulants.—Stimulants are drugs or other substances used to resuscitate one after injury, shock or

exhaustion. One teaspoonful of aromatic spirit of ammonia in a little water is the best. Hot strong coffee, or tea, or a tablespoonful of brandy in hot water, has a stimulating effect. The indiscriminate administration of a large drink of whisky is to be condemned; in fact, it is better not to give alcohol in any form if any other stimulant is procurable, for there are conditions in which alcohol may do more harm than good. A stimulant should not be given to an unconscious person, for he cannot swallow, and the liquid may get in the windpipe and cause strangulation.

Emetics.—An emetic is used to produce vomiting. It may be necessary to empty the stomach when a poison has been swallowed. A teaspoonful of ground yellow mustard dissolved in a cup of warm water is a good emetic. This should be followed by two or three cups of warm water. Vomiting can also be produced by drinking a quantity of warm salt water, and then sticking the finger down the throat.

Antidotes.—Antidotes are given to combat or neutralize the effect of a poison. A chemical antidote forms an insoluble or a harmless compound with the poison; a physiological antidote has the opposite medicinal effect, and neutralizes the poison.

Antiseptics.—Antiseptics are used to prevent infection. Those most valuable in first-aid work are tincture of iodine (half-strength), boric acid, alcohol, carbolic acid, bichlorid of mercury, boiling water, and steam. A half-strength tincture of iodine can be lightly applied to light scratches, cuts, or abrasions. In the absence of iodine, pure grain alcohol can be applied. Pure carbolic acid can be used to cauterize a wound caused by a rusty nail, or a dog bite. Boric acid powder, or a saturated solution, is a valuable mild antiseptic. Bichlorid of mercury is a strong antiseptic and an irritant poison, and should only be used by those who have had some instruction regarding it. Steam and boiling water are splendid for sterilizing dressings or instruments.

Heat and Cold.— Heat is used in first aid in the form of hot applications, the hot water bottle, or hot soaks. Hot compresses will prevent or diminish the swelling following a blow, and also will relieve the pain. The hot water bottle is a good way in which to apply external heat in an effort to revive one suffering from shock, or to relieve pain. Soaking a sprained joint in hot water relieves pain and prevents swelling. Hot soaks are good for stiff, sore or bruised muscles. Cold applied in the form of the ice bag, cold shower, ice pack, or cold compresses, is a valuable first-aid remedy. The ice bag, applied to the head, is used to reduce the temperature of the body, as in fever; the cold shower is a stimulant, especially to respiration; cold compresses are useful to relieve congestion or inflammation in a part, and to contract blood-vessels locally; the ice pack may be used to reduce quickly high body temperature.

Adhesive Plaster and Collodion.—These substances are usually included in a list of first-aid supplies. Their uses are mainly in the retention of dressings applied to wounds. Adhesive plaster should never be applied to an open wound; it is not antiseptic and it dams up the discharge from the wound. Collodion may be used to cover the slightest scratches or abrasions, and to hold gauze or cotton dressings on very small wounds.

GENERAL FIRST-AID RULES

When an accident occurs in the absence of a medical officer, one who has had training in first aid should take charge, restore order, and with confidence and promptness render the necessary first aid. He should ascertain the nature of the injury and immediately begin treatment. The patient should be put in a comfortable position, and if an artery is bleeding, the hemorrhage should be controlled. If an injury is more than trivial, the medical officer should be sent for as soon as possible. *In the meantime, proceed with the necessary first-aid treatment.* Dressings and bandages should be applied to

wounds and splints to broken bones before any attempt is made to transport the patient. If the patient feels faint, a stimulant may be given, but no liquid should be poured down the throat of an unconscious person, for he cannot swallow, and strangulation may result.

FIRST-AID TREATMENT

Resuscitation of a Person Apparently Drowned.—As soon as he has been taken from the water, quickly remove the clothing from the upper portion of the body. Remove the mud, if any be present, from the face and mouth, also any other substances likely to obstruct the passage of air to the lungs. Turn him face downward, and standing over him, clasp your hands under his abdomen, raise him and shake him up and down a few times, allowing the water to drain from his nose, mouth, throat, and air passages. With the patient lying prone, face downward, the head is placed so as to be slightly lower than the body and turned to one side, with the tongue hanging out of the mouth. Kneeling astride the patient, pressure is made with both hands upon the back over the lower ribs. This forces some of the air out of the lungs; relieving the pressure, the normal elasticity of the ribs expands the chest and draws air into the lungs. Repeat this at the rate of about fifteen times a minute. Efforts at resuscitation should be continued for at least one hour. The wet clothing should be removed as soon as possible, warm dry blankets placed around the patient, and external heat applied. As soon as he is conscious and can swallow, give a stimulant, and do not move him until his pulse and respiration are good and regular.

Artificial respiration is also indicated in any condition in which there is a failure of respiration, such as electric shock, suffocation, or collapse. In Sylvester's method the patient lies on his back, and a folded coat or pad is placed under his shoulders, thus forcing the chest upward. Pull his tongue forward, having your thumb and forefinger

covered with a dry cloth to prevent slipping. The tongue should be held forward by an assistant while artificial respiration is performed. If no help is at hand, tie the tongue against the lower teeth with a string, or stick a hatpin through it about one-half inch from the end. This will hold it forward and prevent its slipping back and being "swallowed" and blocking the passage of air through the windpipe. Resting on one knee just behind the patient's head, grasp both his forearms near the elbows and raise them upward and outward, holding them above his head for about two seconds, while the air is entering his lungs. Then lower his arms and press them tightly against his chest for about two seconds, thus forcing some of the air out of his lungs. Do these motions about fifteen times a minute.

Wounds.—Wounds are injuries in which the skin or underlying tissues are divided. They are caused by violence. The various classifications of wounds, interesting to the surgeon, such as open, subcutaneous, incised, contused, lacerated, punctured, gunshot, stab, or poisoned, are not necessary to the first-aid student. Wounds are to be classified by him according to the first-aid treatment he is to administer. They are wounds with or without hemorrhage, large or small wounds, and clean or infected wounds.

Symptoms: Pain, more or less bleeding, retraction of the edges, loss of function, and shock.

Treatment.—(*a*) Wounds with hemorrhage. Control the hemorrhage by the use of the tourniquet applied between the wound and the heart, or by pressure over the artery at some distance above the wound. Prevent infection by the prompt application of a sterile gauze compress. Under no circumstances should the unsterilized hand touch a wound or that part of the compress which comes in contact with the wound. Add two or three compresses over the first one and bandage firmly. Elevate the injured part and put it at rest; then carefully *loosen the* tourniquet. Should severe bleeding recur,

tighten it again. Get the patient to the medical officer as soon as possible. If more than a half hour should elapse before the services of a doctor can be secured, the tourniquet must be loosened for a few seconds, so as to prevent gangrene; if bleeding continues, reapply it.

(*b*) Wounds without hemorrhage. Cover the wound with a sterile gauze compress and bandage, using care to prevent infection. A firm bandage over a compress will usually control the slight bleeding.

(*c*) Small wounds, scratches, cuts, or abrasions. Touch with a half-strength tincture of iodine. Apply a sterile gauze compress and bandage the wounds and cuts; no dressing is necessary on the slight scratches or abrasions.

(*d*) Large wounds. Allow the wound to bleed for a few seconds; the small amount of blood lost will not harm the patient, and it will wash away some of the infection. Apply the sterile gauze compress and bandage firmly. This applies to clean wounds.

(*e*) Infected wounds. Apply sterile gauze compresses to the wound and bandage. Get the patient to the medical officer immediately; if this is not possible, wash the dirt, grease, particles of clothing, or other foreign substances from the wound, using sterile water, boric acid solution, alcohol, or ether, and then put on the sterile dressings, using precautions to prevent additional infection. If none of the antiseptic solutions mentioned is at hand, cover the wound with sterile dressings and bandage.

Fractures.—A fracture is a broken bone. A simple fracture is one in which the skin is not pierced by the end of the broken bone. In a compound fracture the sharp end of the broken bone tears or protrudes through the skin. Fractures are caused by falls, blows, or muscular action. In addition to the above-mentioned causes, compound fractures are caused by rifle balls, shell fragments, or by the rough or unskilful handling of a simple fracture.

Symptoms: Pain, swelling, tenderness, deformity, un-

usual mobility, crepitus, more or less shock, and inability to move voluntarily the injured limb.

Treatment: (*a*) *Simple fracture:* Put the patient in the most comfortable position; send for the medical officer; prevent further injury by handling or moving the injured limb as little as possible. If the patient has to be moved before the services of a doctor can be secured, preparations for transportation must be made. Apply a splint and bandage firmly, but not too tightly. Use a sling if an arm is broken.

(*b*) *Compound fracture:* In addition to putting the patient in a comfortable posture, and sending for a doctor, hemorrhage, if present, must be controlled. Expose the wound by cutting away the clothing, apply a tourniquet to stop the bleeding, put on a sterile gauze compress and bandage. Then apply the splint and get the patient ready for transportation.

Hemorrhage.—Hemorrhage is loss of blood from an artery or vein. Bleeding from an artery comes in jets or spurts; from a vein there is a steady flow. Bleeding from a large artery must be stopped within a few seconds, or the patient will bleed to death, or go into a state of shock.

Treatment: Check the flow of blood by the application of a tourniquet at a little distance above the wound, and between the wound and the heart. Pressure made with the fingers over the artery will temporarily check the flow of blood until a tourniquet can be applied. Apply a large sterile compress and bandage firmly. Release the tourniquet carefully, keep the patient quietly in the recumbent posture, and, should severe bleeding recur, reapply the tourniquet.

Shock.—Shock is a depression of the nervous system; it is sometimes called collapse. It is usually caused by a severe injury.

Symptoms: Following an injury partial or total unconsciousness may occur. The face is pale, skin cold and

clammy, eyes dull, breathing shallow or labored, and the pulse is rapid and feeble.

Treatment: Place the patient in the recumbent posture, with the head a little lower than the feet, so that the blood will tend to flow toward the vital centres. Give a stimulant, such as aromatic spirits of ammonia or hot coffee, if the patient is conscious and can swallow. Wrap a blanket around him and apply external heat. Ammonia or smelling salts may be held near his nose; the application of cold water or cold cloths to the head and gently rubbing the limbs toward the body are also helpful.

Dislocations.—A dislocation is an injury to a joint due to the forcible displacement of one or more bones. Ligaments are torn. The cause is a fall, blow, or muscular effort.

Symptoms: Deformity, which can be seen by comparison with the uninjured side; limited motion; pain; the head of the bone may be felt out of its normal place; the limb will be longer or shorter than the other; there may be swelling or discoloration; and shock may be present.

Treatment: Make no effort to reduce any dislocation, for severe damage may be caused by the attempts of unskilled persons. Place the patient in a comfortable position, cover the injured joint with hot compresses, treat shock, if present, and send for a medical officer. If it is necessary to transport the patient, the limb should be bandaged firmly in the most comfortable position before starting, so that no further damage will be done.

Sprains.—A sprain is a stretching, twisting, or tearing of a ligament about a joint. It is usually caused by a sudden twist, or an unnatural movement of the joint.

Symptoms: Sudden severe pain, which is increased by motion or pressure on the joint. There is also swelling and redness, and shock may occur in severe cases.

Treatment: Immediately apply cold to the sprained joint. This is best done by immersing it in ice water, or

applying cold compresses or the ice bag, for a period of about thirty minutes. Then bandage, put the joint at rest and elevate it. If treatment is begun later than a half hour after the injury has occurred, apply heat, either by soaking the joint in hot water, or applying hot compresses, or the hot-water bag. A sprain is usually not a trivial injury, and therefore should be kept at rest until seen by a medical officer.

Bruises.—A bruise or contusion is an injury caused by a blow of a blunt weapon, or a fall, or other violence not of sufficient force to break the skin. Blood-vessels under the skin are broken and the escape of blood and serum causes the swelling and the black and blue marks.

Symptoms: Pain, discoloration and swelling.

Treatment: This depends upon the size and location of the bruise, and the length of time which has elapsed since the injury was received. A slight bruise, except in loose tissues, such as around the eye, needs no treatment, especially if there is no pain. For severe bruises, the immediate application of ice or cold compresses will lessen the pain, and limit the swelling by contracting the vessels from which the blood is escaping. After half an hour the application of heat is indicated. Hot compresses, rest and elevation of the injured part will relieve pain and tenderness and aid in the absorption of the swelling.

Strains.—A strain is an overstretching or tearing of the fibres of a muscle, due to exertion, overuse, or a sudden wrench.

Symptoms: Soreness and lameness of the muscle; in severe cases, swelling.

Treatment: Rub the strained muscle with liniment, alcohol, or hot water. The choice of the liniment is immaterial, as the rubbing is most important. Rest the injured muscle until the soreness disappears.

Burns and Scalds.—Burns are lesions caused by the action of dry heat on the tissues. Scalds are caused by *moist heat.* There are burns of the first, second and third

degree, and the symptoms and treatment vary according to the degree. A burn of the first degree is a redness of the skin; of the second degree, blistering; while in burns of the third degree there is charring and destruction of the tissues.

Symptoms: Pain, shock, and local injury depending upon the degree.

Treatment: (*a*) Burn of the first degree. Apply boric acid ointment, vaseline, or any clean oil or mild ointment. A thin paste made with water and bicarbonate of soda, starch, or flour is soothing and protective.

(*b*) Burn of the second degree. Carefully remove the clothing; if it adheres, soak it loose with oil, peroxide of hydrogen, or warm water. Prick the blisters at their lowest point and allow the serum to escape. Then apply a compress to which has been added any of the remedies mentioned in the treatment of first degree burns, and bandage. If the services of the medical officer are available within an hour, the only treatment necessary is the application of the compresses with any one of the above-mentioned remedies.

(*c*) Burns of the third degree. Cover the burned area with dressings soaked in boric acid solution or oil. Put the patient at rest; give a stimulant, and get a doctor as soon as possible.

Burns by acids should be treated by the application of weak alkaline solutions, such as lime water, or a solution of bicarbonate of soda; and alkali burns with weak acid applications, such as vinegar, or lemon juice. Burns by electricity and sunburn are treated in the same manner as other burns of like degree.

Sunstroke.—Sunstroke, or heatstroke, is a condition caused by exposure to excessive heat or to the direct rays of the sun. It is more apt to occur to those who are addicted to the excessive use of alcoholic liquors, or are in a debilitated condition.

Symptoms: Dizziness, headache, dryness of the skin; later, unconsciousness or convulsions. The face is red,

eyes congested, pupils dilated, breathing labored, and pulse slow and full. The skin is reddened and feels hot to the touch.

Treatment: Remove the patient to a cool, shady spot, loosen the clothing, and remove as much as possible or expedient. Bathe the head, face and chest with cold water, or hold ice to the head. Give water to drink when consciousness returns. No alcoholic stimulant should be given.

Heat Exhaustion.—A condition of collapse or great depression due to excessive heat and humidity. Frequently occurs in fire rooms.

Symptoms: Weakness, dizziness, more or less collapse, moist clammy skin and weak pulse.

Treatment: Get the patient out of the hot humid compartment to a place where the atmospheric conditions are more favorable. Give a teaspoonful of aromatic spirits of ammonia in a small amount of water, and bathe the face and head with cool water. In those cases in which the patient is cold and chilly, and the temperature subnormal, a warm bath or external heat is indicated. He should be kept at rest until the depression disappears or until the services of the medical officer are obtainable.

Foreign Body in the Eye.—Foreign bodies, usually cinders or dust, lodge most frequently on the inner surface of the upper lid; as a rule gentle rubbing once or twice, or pulling the eyelid away from the eyeball and then downward over the lower lid is sufficient to remove most foreign particles. Frequent rubbing firmly fixes the substances in the tissues and should be avoided. To remove a foreign body from the eye of another person, cover the end of a match with a bit of cotton or a handkerchief, have the patient look downward, gently grasp the eyelashes between the thumb and forefinger and pull the eyelid away from the eyeball. Place the end of the match over the centre of the outer surface of the upper lid and press downward, at the same time pull the end of the lid upward, thus everting the lid. Then remove

the particle from the lid with the covered end of the match.

Foreign Body in the Ear.—These cases should be referred to the medical officer, for much harm may result from unskilled manipulation in attempts at removal. Insects in the ear cause great annoyance, which can be relieved by dropping in oil or glycerine.

Frost Bite.—This is the effect of intense cold on exposed portions of the body, or distal parts where the blood circulation is limited, such as the fingers, ears, tip of the nose, or toes.

Symptoms: The affected part is painfully cold, followed by loss of sensation; skin is purplish or white.

Treatment: Gradually restore the temperature of the affected part to the normal point. This is best done by rubbing with cool, then tepid, and later warm water, or by applying moist compresses of gradually increasing temperature. Soaking the part in very hot or very cold water is harmful.

Freezing.—Freezing is that depression of vitality caused by the prolonged exposure to extreme cold. Lowered resistance caused by hunger or fatigue, insufficient clothing, and indulgence in alcoholic liquors are contributing causes.

Symptoms: General numbness, mental and physical torpor, later unconsciousness; the skin is deathly white and the limbs stiff.

Treatment: Gradually restore body temperature as described in the treatment for frost bite. A sudden change of temperature would be very unfavorable, so the rubbing must first be done in a cool room. After consciousness has been restored, and the pulse is improving, give a stimulant and surround the patient with warm blankets.

Snake and Insect Bites.—Snake bites usually occur at a time when the services of a medical officer are not available, and first-aid treatment must be given instantly by the person bitten or by a companion.

Treatment: Tie a handkerchief or string around the limb above the bite, that is, between the bite and the heart. This will confine the poison and prevent its reaching the heart by way of the blood stream. Suck the poison from the wound. Care should be taken that none of the poison is swallowed and that there are no cracks or abrasions on the lips or mucous membrane of the mouth. With a sharp knife make an incision about one-half inch long in the long axis of the limb, thus enlarging the bite and promoting the flow of blood from the wound. The blood will help wash away the poison. If it is not practicable to make the cut at the site of the bite, apply ammonia water, or if this is not available, soak the bitten part in water, preferably hot. Brandy, whisky, aromatic spirit of ammonia, or other stimulants, should be given freely. It is a mistake to get the patient drunk, for in that condition the stimulating effect of alcohol is lost, depression follows, and the resistance is lowered. In about half an hour loosen the ligature for only a few seconds, and tighten it again. This will allow the blood to flow for a short time in that portion of the limb constricted by the tourniquet, thus preventing gangrene, and permitting only a small amount of the snake poison in the general blood circulation. Repeat in a few minutes, and if no ill effects are noticed, very gradually loosen and remove the constricting band. If, however, faintness or collapse occurs when the band is first loosened, tighten it up again, and take the chances of gangrene rather than death. Take the patient to the medical officer as soon as possible.

The bites of insects are best treated by the application of ammonia water. The stinging or burning sensation caused by coming in contact with a jellyfish is relieved by the application of ammonia water, or weak carbolic solution.

Poisons and Poisoning.—The apparent ease with which deadly poisons can be procured, and the frequency *of suicides* and deaths due to poisons, make this subject

of unusual interest. The poisons most commonly taken with suicidal intent are carbolic acid, preparations containing opium, and bichlorid of mercury. Those mistaken for other drugs or medicines are bichlorid of mercury, which is mistaken for headache tablets; wood alcohol, which is confused with grain alcohol; laudanum, sometimes mistaken for cough medicine, and oxalic acid, which closely resembles Epsom salts. In all cases of poisoning send for a medical officer at once, and begin first-aid treatment pending his arrival.

Poisons are classified as narcotic, irritant, and corrosive. A narcotic poison is one which in large doses produces stupor, delirium, depression, or unconsciousness. A general rule in the treatment is to give an emetic promptly; neutralize the effect of the poison by giving the chemical or physiological antidote, if it is known, and overcome the depression with stimulants. Examples of narcotic poisons are opium, belladonna, aconite, alcohol and chloral.

Irritant poisons cause pain, irritation, and inflammation of the gastro-intestinal tract or abdominal viscera. A general rule for treatment is to give a chemical antidote, so that a harmless or insoluble compound is formed; give an emetic, and then mild soothing liquids, such as raw eggs, milk, flour and water, oil, soapy water, or milk of magnesia. Give stimulants, if necessary. Examples of irritant poisons are oxalic acid, arsenic, iodine, strychnine, lead, antimony, copper and zinc.

Corrosive poisons burn, deeply scar, or destroy tissues with which they come in contact. Diluted corrosive poisons are irritants. The treatment consists in neutralizing the poison, that is, giving a weak acid such as vinegar or lemon juice, if the poison is a strong alkali; and weak alkalies, such as limewater, or mixtures of soda, magnesia or chalk for acid poisoning. Do not use an emetic or a stomach tube when a corrosive poison has been taken. Sweet oil, milk, olive oil, raw eggs, or mucilaginous liquids should be given to allay the burning and inflam-

mation. Alcoholic stimulants do harm. Examples of corrosive poisons are sulphuric, nitric, and carbolic acids, lye, and caustic potash and soda.

Carbolic Acid Poisoning.—This can be recognized by the odor of the drug, and by the white burns on the lips and in the mouth. There is great pain in the throat and stomach and the patient soon goes into a state of collapse.

Treatment: Give a large dose of Epsom salts. Rinse the mouth with pure alcohol, whisky or brandy, and a small amount of the alcohol diluted with water should be swallowed. After the antidote has been given, soothing substances, such as olive oil, sweet oil, or raw eggs, should be administered to allay the burning and irritation in the mouth, throat and stomach. Give stimulants, if necessary, and keep the patient warm .

Opium Poisoning.—Opium is poisonous in the form of laudanum, paregoric, morphine, Dover's powder, and is an ingredient in many cough mixtures, soothing syrups, and other patent medicines. An overdose of any of these patent medicines may cause opium poisoning.

Symptoms: Drowsiness, slow and labored breathing, contracted pupils, and livid face. Pulse is slow and full, later it becomes weak. Unless treatment is begun promptly, unconsciousness may follow.

Treatment: Give an emetic at once and repeat until it is effective. There may be some difficulty in getting the patient to vomit because of the stupor. After the stomach has been emptied, give plenty of hot, strong, black coffee. Do not allow the patient to fall asleep; keep him awake by applying alternate cold and hot cloths to the head, face and chest. Perform artificial respiration if the breathing becomes very slow, and at the same time tell the patient to breathe, shouting it in his ear. Alcoholic stimulants should not be given.

Bichlorid of Mercury Poisoning.—When taken by *mistake*, the disagreeable metallic taste will disclose its *identity*. Other symptoms are vomiting, intense pain in

the abdomen, and white shrivelled mucous membrane of the mouth and throat.

Treatment: Three or four raw eggs should be swallowed at once. Then give an emetic, and see that the stomach is well emptied. Overcome depression by the administration of stimulants.

Wood Alcohol Poisoning.—Poisoning by wood alcohol is especially dangerous, and used to be a frequent cause of death in the navy. Those who escape death are frequently totally blind. It can be distinguished from grain alcohol by its odor, which somewhat resembles the odor of a not strictly fresh egg.

Symptoms: Nausea, vomiting, severe abdominal pains, loss of vision, and collapse.

Treatment: Promptly produce vomiting by the use of an emetic, and give stimulants.

Oxalic Acid Poisoning.—Oxalic acid is used for cleaning and bleaching purposes, resembles Epsom salts or sugar, and is frequently mistaken for them.

Symptoms: Pain and burning in the abdomen, nausea, vomiting, and signs of collapse.

Treatment: Lime is the best antidote, and should be promptly and freely given in the form of limewater. If this is not available, take plaster from the wall, or white crayons, or tooth powder, mix with water, and give it to the patient. Milk of magnesia in large doses may be beneficial. Follow the antidote with an emetic, and stimulate if signs of collapse are present.

Alcohol Poisoning.—A large number of alcoholic drinks taken in rapid succession or a large amount of alcoholic liquor taken at once will cause acute alcoholic poisoning. This is a dangerous condition and death may result if it is not treated promptly.

Symptoms: Early symptoms of intoxication are well known. Later dangerous symptoms are collapse, cold, moist skin, slow, shallow breathing, rapid, weak pulse and unconsciousness. Pupils are equal and dilated. Be careful not to mistake apoplexy for acute alcoholism.

Treatment: Produce vomiting; give a cup or two of strong hot black coffee or two teaspoonfuls of aromatic spirit of ammonia. Put the patient to bed, apply warmth to the body, and cold cloths to the face and head. Perform artificial respiration if the breathing becomes weak or irregular.

Gasoline Poisoning.—The extensive use of gasoline and heavy oils as fuel for engines in submarines and motor boats has resulted in a number of cases of poisoning from the inhalation of the fumes from the engine exhaust. These fumes may be present in the engine room, may be blown from the exhaust pipe by a breeze toward the bridge or deck, or may be drawn into the boat from another submarine charging batteries alongside.

Symptoms: Headache, weakness, languor, irritability, and dizziness. Severe cases pass on to mental confusion, delirium, or coma. Occasionally cases become confused suddenly or pass into a state of coma before other symptoms are noticed. These are dangerous and require prompt treatment. The face is flushed early, and later becomes pale, the pulse is weak, the skin is cold and clammy, and convulsions may occur. Sometimes cases in which the symptoms have been mild suddenly collapse when taken into the fresh air, but they are easily revived by appropriate treatment, and only a headache remains.

Treatment: Get the patient in the fresh air as soon as possible. If he is conscious, give him two teaspoonfuls of aromatic spirit of ammonia in a little water. If in a state of collapse, perform artificial respiration, apply external heat, and bathe the face with cold water.

Drinking raw gasoline, or inhaling the fumes, produces symptoms resembling a mild form of alcoholic intoxication. The treatment is the same.

Iodine Poisoning.—Iodine tincture is extensively used in first-aid surgery. It is in all medical lockers or first-aid kits, and may be mistaken for another medicine.

Symptoms: Pain and burning in the mouth, throat, and abdomen; nausea and vomiting.

Treatment: Give starch and water freely, followed by an emetic. Symptomatic treatment should be given as indicated.

Nosebleed.—This is usually a symptom of some underlying condition, such as an ulcer in the nose, or high blood pressure. It may follow an injury, and frequently occurs without any apparent cause.

Treatment: Slight nosebleed requires no other treatment than rest. Severe bleeding should be treated by placing the patient in a chair, with his head held backward, loosening tight clothing around the neck, and applying cold compresses, or ice, to the back of the neck, and to the nose. If these measures are not sufficient, get a medical officer, for it may be necessary to pack the nostril.

Apoplexy.—This is a very serious condition likely to be mistaken for other illnesses. Only simple first-aid measures should be taken, as much harm may result from overtreatment. Apoplexy is caused by pressure on the brain by blood escaping from a diseased vessel.

Symptoms: Sudden unconsciousness, face congested, pupils unequal, pulse slow and full, breathing labored, and paralysis of one side of body. Apoplexy may be mistaken for alcoholic intoxication, opium poisoning, or epilepsy.

Treatment: Place the patient at rest in the recumbent posture, with the head slightly elevated. Loosen tight clothing, especially about the neck. Apply cold compresses or ice to the head, and warmth to the extremities. Do not give a stimulant. Get the patient to the medical officer as soon as possible.

Epileptic Fits.—An epileptic is absolutely unsuited for military service, but occasionally one is enlisted inadvertently. If a man has an epileptic seizure, or any kind of fit, it should be reported, so that he may be placed under observation. An epileptic is a dangerous man aboard ship. Not only may he fall overboard when in a fit, or otherwise seriously injure himself, but he may imperil the lives of others, or the safety of the ship, should a seizure come on at a critical time.

Symptoms: A sharp cry precedes the fall to the ground. Convulsions occur, during which he froths at the mouth, and bites his lips or tongue. His face becomes livid, the eyes are open and rolled upward. Convulsions last a few minutes, followed by a gradual return to consciousness. For some time after, the patient's mind is dull and there is an inclination to sleep.

Treatment: Get the patient on his back in a comfortable position, loosen tight clothing about the neck, and prevent those movements which might do him injury. Biting the tongue can be prevented by placing a folded handkerchief or a stick of wood between the teeth. After the convulsions have ceased, let him sleep, but keep him under observation.

In the foregoing conditions, only the simplest and most necessary procedures have been outlined, because it is a mistake for a person giving first aid to try to do too much. In so doing harm may result to the patient.

ORGANIZATION OF THE MEDICAL DEPARTMENT ABOARD SHIP[1]

Relief of Wounded.—Modern naval warfare presupposes a high casualty rate and a rapid accumulation of wounded, but the casualty rate will vary widely on different ships, probably being highest in the leading divisions. Any effective organization of medical personnel to meet the demands of the wounded in a naval engagement will usually go beyond the facilities of a single ship, and will necessitate the adoption of a more comprehensive scheme of assistance external to the ship, but every vessel should be self-sustaining so far as practicable, and no effort should be spared to attain this end. When wide dispersion of the ships or other conditions render outside assistance unavailable, the measures to be adopted by the ship's resources alone during and subsequent to battle will comprise the following:

Continuous First-aid Service to the Wounded Dur-

[1] *From* Manual for the Medical Department, U. S. Navy.

ing Battle on the Part of the Personnel at Large.—The effectiveness of this service will depend largely upon the thoroughness with which the units have previously been instructed by the medical and divisional officers, as required under the regulations, and how well they have become imbued with the principle that first aid, calmly administered by themselves or comrades, represents the maximum service that can be rendered the wounded during the height of a naval action. The ship's force should have been warned that elaborate measures of treatment or extensive transportation during battle are both inadvisable and impracticable. The wounded man, after the administration of first aid, should be placed to one side, where his presence will be least felt and where he will not incommode or disturb the fighting force.

In a suspension or lull of the battle or after the engagement, upon notice from the central station, and when prompt treatment of the wounded in or near the fighting position is denied or deferred for any reason, the stretcher men may be required to seek out and transport certain of the wounded to the battle dressing stations. It should be the first duty of the medical officer to give attention to such of the wounded as may render further service at the guns or elsewhere after the application of the appropriate treatment. These men should be promptly returned to their stations. It must be borne in mind that the primary purpose of first aid is to keep as many effectives at their stations as possible. A graver class of injuries may require deliberate surgical intervention, but extensive procedures on the part of the ship's force are only legitimate if evacuation of the wounded for any reason is delayed or rendered inadvisable. The personnel of the Medical Department should institute a search for the seriously wounded to afford relief and prepare a list of the dead as soon as practicable. To assure the wounded early and efficient treatment, effect their rapid removal from the fighting ship, and insure a continuous record of each case is the object of the organization.

General Quarters.—When at exercise simulating action (in so far as it is possible to do so), the medical officer will employ this opportunity to instruct the personnel of the dressing stations in their duties, assuring himself that all members of the ambulance party are competent to administer first aid; that they understand their stations and the limits of the ship assigned to them, and the usual routes of transport to and from the groups of personnel. At drill, the dressing stations will not be equipped in advance of signal "general quarters."

Battle Dressing Stations.—Battle dressing stations should be easy of access and located behind armor. Routes to dressing stations should be indicated by an arrow and a red cross. There should be at least two, one being installed as a main or primary station, and one as an accessory or secondary station. The stations should have an abundant supply of drinking water, all connections being installed behind armor. As these connections might nevertheless be interrupted, storage tanks for drinking water should be provided, having a capacity sufficient to furnish in first-class ships one gallon of water per man, allowing for twenty per cent. of wounded. Dressing stations should also be well ventilated, well lighted, and as cool as the surroundings will permit. It has been estimated that each thirty-six square feet of area should be provided with one cargo light of approximately 200 candlepower (6 lamps). If possible, connections for electric lights should be distributed on two circuits; lanterns or some other means of lighting should be available in case the electric lighting circuits suffer interruption. Electric or steam connections should be provided for the water, dressing, and instrument sterilizers. In ships wherein proper connections are provided, sterilizers should be removed from the surgical operating room and set up in the main dressing station prior to action. When so installed they should remain during the period of hostilities. If possible, there should be some provision made for the drainage of this space. In the

vicinity of the dressing station or adjoining it, there should be arranged a berthing space for the wounded sufficient to accommodate about 10 per cent. of the complement. This space should be easy of access from the dressing station, and, like the latter, have an abundant air supply. In addition to the usual equipment transferred from the sick bay and operating room and distributed in the dressing stations, the following articles should be provided: electric fans, with proper connections; half tubs; water buckets; swabs and brooms; washing stands; tables for apparatus; shelves; supports or hooks for irrigators, etc.; dressing lockers; bedding for the berthing space for wounded; restoratives, etc. A reserve supply of surgical dressings should be available on this deck in a secondary station, behind armor, and accessible for distribution to the dressing stations, if required.

The station of the medical officer of the ship during action, will, as a rule, be at the main (operating) dressing station, where he will see that the necessary equipment is provided.

Preliminary to battle the personnel should be required to bathe and put on clean underclothing.

Means of identification of the dead, as required by Article 17 of the Tenth Hague Convention, should be provided for each officer and man.

The organization of the Medical Department, showing all dispositions under battle conditions, should be worked out for the ship as soon after going into commission as practicable. Provision should be made for instruction of officers and men in first aid for the equipment and organization of battle dressing stations, as described above; and for a definite organization of the personnel of these stations, as well as for their progressive instruction in first aid and transportation methods. During action the difficulties of transportation preclude any extensive exercise of the functions of the stretcher men, and as their most important duties are to be performed when the action is over, or during intervals of action,

they will avoid exposing themselves unnecessarily. Such emergency work as is feasible will be performed.

The galley and bakery in ships of old type, if intact after an engagement, may be placed at the disposition of the medical officer for preparing additional hot water and dressings and for sterilizing instruments.

Operating Room.—If not dismantled, the ship's operating room may be made use of after the action to supplement the work of the dressing stations, provided the removal of the gravely wounded direct to hospital ships is not feasible.

Transportation of Wounded.—Apparatus will be provided by the Medical Department of the ship for transportation of wounded, but complicated appliances liable to disablement will be avoided. Simple measures designed to facilitate transporting wounded by stretcher directly to the dressing stations by the most convenient hatch, down which they will be lowered or passed by hand to the deck below, or over the side to boats from the hospital ship, are to be preferred to more elaborate means of transport.

A suitable place should be assigned for the disposition of the dead.

When the medical transport or hospital ship is at hand, the seriously wounded should be transferred as promptly as is consistent with their welfare. A fighting ship should be cleared of such cases as soon as possible after an action, in order that she may be ready to re-engage in battle. On the other hand, patients who will probably soon be fit for duty should be retained on board, and these may constitute a large proportion of all cases.

ORGANIZATION OF THE MEDICAL DEPARTMENT IN THE FIELD[2]

The functions of the Medical Department in the field fall under the following headings: (*a*) Sanitation; (*b*) Professional care and treatment of sick and wounded;

[2] *From* Manual for the Medical Department. U. S. Navy.

(*c*) Providing medical and hospital supplies; (*d*) Collection and evacuation of sick and wounded.

Assistance will usually be rendered to the wounded at the following points: (*a*) the regimental aid stations; (*b*) the dressing station; (*c*) the brigade hospital; (*d*) the base hospital (hospital ship or other ship).

At the beginning of an engagement the wounded are cared for by the regimental ambulance party. Those able to walk are taken to sheltered places as soon as possible, out of the way of advancing troops.

Regimental aid stations are established under shelter by the regimental surgeons as near the firing line as possible. If the enemy's fire is such that the wounded cannot reach the station, advantage is taken of the character of the terrain affording temporary shelter, and the wounded are brought in during lulls in firing or after nightfall. At this station the hospital corpsmen shall be prepared to apply tourniquets, adjust temporary splints, apply protective dressings, and administer stimulants. They should carry knives or heavy bandage shears for cutting away clothing in addition to the usual equipment contained in the Hospital Corps pouch. The wounded who are able to walk will, after the application of a simple protective dressing, be marched to the dressing station or, in the case of trivial wounds, be directed to resume their posts on the firing line. The wounded who are unable to walk will be carried from the aid station to the dressing station (or direct to the field hospital).

The brigade dressing station is the assembling point for the wounded from the regimental aid stations. It will be located at some point protected from rifle and artillery fire, accessible to the aid stations, and at a point that can be reached by ambulance or other transportation. A water supply, and firewood or other fuel, are desirable features at this point.

The dressing station will be designated by a Red Cross flag by day and a white over green light at night. At this station all dressings will be carefully examined, but

not renewed unless absolutely necessary. Tourniquets will be removed and bleeding vessels tied, splints readjusted, and the wounded classified and tagged. Examination of wounds shall be restricted as much as possible, and the cleaning of the wound and the surrounding skin limited to what is absolutely essential. Water, food, and stimulants will be served out as required. After inspection, treatment, and classification of the wounded they will be transported to the rear as soon as possible.

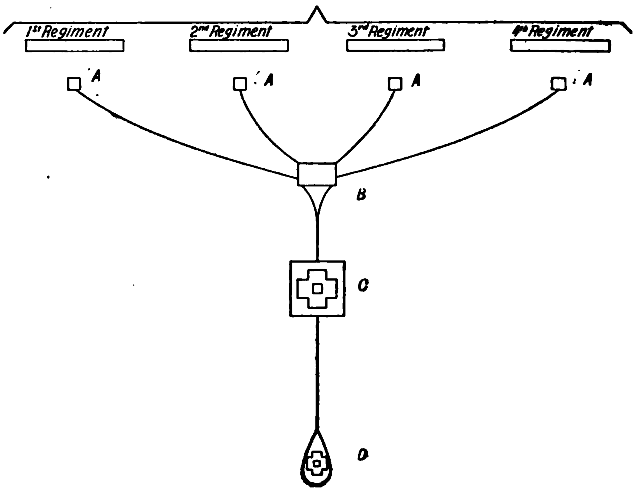

FIG. 32.

A. Regimental aid stations: Here skulkers should be checked and effectives separated from non-effectives. *B*. Brigade dressing station: Not necessary when a regiment is acting singly. Here cases are assembled from the whole brigade for classification and transport to rear. *C*. Brigade hospital: Not necessary if operating near base. Located 3 to 4 miles in rear of dressing station, out of range of weapons. *D*. Base hospital: Not necessary if a hospital ship is used as base hospital.

The aid and dressing stations are of necessity of a temporary character, and should be kept as mobile as the character of the work at hand will permit.

If the landing force is on distant service a field hospital may be necessary. This hospital should be located beyond the zone of conflict, usually three or four miles in rear of the dressing station.

The brigade hospital receives the wounded from dressing stations and retains them for treatment only so long as may be necessary to arrange for their further transportation to the rear (base hospital). Only urgently necessary operations will be performed at this point, and the brigade hospital should be promptly cleared of all wounded as soon as their condition permits of transportation. The brigade hospital will fly a Red Cross flag by day and a green over a white light at night.

The base hospital will be established at the advance naval base. This hospital may not be needed, or needed only as a receiving station, or convalescent camp or reserve hospital, if a hospital ship is available.

HYGIENE

"Public health is the foundation on which repose the happiness of the people and the power of a country. The care of the public health is the first duty of a statesman."—DISRAELI.

PERSONAL HYGIENE

One of the most important duties of a person in the naval service is to keep himself physically fit. It is the foundation on which rests his mental and military efficiency. To attain and maintain a high state of physical fitness one must learn and obey the rules of personal hygiene. Medical officers of the navy to-day are more concerned about the prevention of sickness than ever before, and to this end are efforts made by careful inspections of the surroundings of the men, their food, and regular periodic physical examinations of the men themselves.

Bathing.—A bath should be taken daily, immediately after rising in the morning being the best time. A warm shower, ending with cool or cold water, is the most beneficial. While the cold water is running let it fall on the chest and at the same time take deep breaths. The shower should be followed by a brisk rub down with

a rough towel. This is a splendid way in which to start the day. The lungs are expanded, the skin is cleaned, the circulation is stimulated and the mind is awakened for the day's work. A clean body is conducive to a clean mind.

The best prelude to a bath is exercise. If one has time, a series of setting-up exercises for ten minutes before the bath will aid in getting up a mild perspiration, and this makes the bath all the more enjoyable. Exercise at any time during the day should be followed by a bath. This will remove the perspiration and the odor accompanying it.

Swimming is to be recommended whenever possible. It is not only cleansing but is also one of the most enjoyable and beneficial forms of exercise. Care should be used that the water in which the swimming is done is clean and free from sewage.

Cleanliness of the hands and nails, especially at mealtime, is an important rule of hygiene. Before sitting down to a meal or handling food the hands should be thoroughly washed and all dirt removed from under the nails. Many infections of the mouth and gastro-intestinal tract are caused by not following this rule.

Care of the Mouth.—A large percentage of the diseases with which the human body is afflicted finds entrance to the body through the mouth or nose. Therefore, the care and cleanliness of these cavities should not be neglected.

The teeth should be brushed five times a day: the first thing after arising in the morning, after each meal, and before turning in at night. A moderately stiff brush with bristles of different lengths should be used, so that remaining particles of food will be removed from between the teeth. An up-and-down motion of the brush, or an inverted V motion, is correct on the outer surfaces of the teeth. The back-and-forward motion of the brush across the teeth does not remove much of the remaining food particles between them, and it is injurious to the teeth.

A good smooth tooth paste is preferable to a gritty powder, as the latter tends to irritate the gums.

All cavities or decay of teeth should be repaired by a dentist as soon as discovered, and the teeth ought to be inspected regularly. Tender and bleeding gums are frequently an early symptom of a very serious condition called pyorrhœa, and should receive medical treatment as soon as noticed. A mouth wash and gargle of a mild antiseptic solution is of value in keeping the mouth and throat clean and free from infection.

One of the most frequent ailments in the navy is an irritation or inflammation of the tonsils and the back of the throat, or the pharynx. This may be caused by bacteria gaining access to the throat, or unclean mess gear, the common drinking cup, by the inhalation of germ-laden dust or irritating gases, or by excessive smoking. This condition is prevented by avoiding the above-mentioned causes and by the use of a mild antiseptic gargle morning and evening. All cases of this sort should receive attention at the sick bay and thus prevent their becoming worse, and what is more important, keep the infection from others.

The Nose.—The nose is the place through which we should breathe. It should be kept clear and clean. The habit of blowing a mighty blast through both nostrils at once into a handkerchief is a bad one, because it suddenly raises the air-pressure in the nose and throat and may force infected material into the eustachian tubes and thereby cause ear disease. Picking the nose, or the pulling of hairs therefrom, may cause infection and boils inside the nose.

The Ears.—Accumulation of wax causes dizziness and ringing in the ears. Matches, toothpicks, or any small article, should not be introduced into the ear in an endeavor to remove the wax. Ofttimes much damage is done in this manner. Infections of the outer ear are sometimes caused by polluted water when in

swimming. These conditions should receive attention and treatment by the medical officer.

Protection of the ear-drums from air blasts during target practice with guns or from roar of the engines in submarines is necessary to prevent damage to the ear-drum and subsequent impairment of hearing.

Clothing.—The clothing worn in the navy is prescribed by the uniform regulations. However, there are a few general rules which are not without value if followed. Cleanliness protection, moderate warmth, freedom from pressure and sufficient ventilation are considerations which should influence the style, material, and manner of wearing the clothing. Only the minimum amount of clothing necessary to secure warmth should be worn. The best material for underclothing is cotton or linen. These permit proper ventilation of the skin and favor the rapid evaporation of moisture due to perspiration. Woolen material absorbs moisture and holds it longer than the other materials and therefore is unhygienic.

The United States Navy Regulations, I 2617, paragraph 3, says:

" Division officers shall inspect clothing once a month, and oftener if necessary, in order to ascertain that it is clean, properly marked, and of uniform pattern, that previous issues are duly accounted for, and to take note of any deficiencies; and the necessary steps shall be taken to see that every man is provided with a proper amount of stowage space for his clothing. In granting clothing requisitions, due regard shall be paid to the necessities of the individuals of the crew and the state of their accounts, keeping them, if possible, out of debt. Nothing but the regulation uniform shall be worn; and in arranging the dress for the day commanding officers and senior officers present shall prescribe such as is adapted to the climate, with prompt changes to meet varying conditions of weather, so as not injuriously to affect the health. *Clothing* wet by perspiration must be dried and, if possible, *washed* before being stowed away. At morning inspec-

tion, from which no one shall be excused unless necessary, a careful examination shall be made to see that the clothing is clean, neat, and in accordance with the order for the day. Every reasonable opportunity and facility shall be given to the crew to make, mend, mark, and wash their clothing."

Paragraph 4, referring to the cleanliness of bedding, says:

"Bedding shall be aired once a week, each piece being separately shaken out and hung up, arranged along the ridge ropes and rails without intervals. All bedding shall be of the uniform pattern and color; each man shall have two mattress covers and change them frequently; the mattresses shall be picked over and the tickings washed at least once a year; blankets shall be washed as often as necessary, special facilities, if possible, being given to firemen, mechanics, and others whose bedding requires frequent inspections and much care."

The amount of water allowed to each man is prescribed by paragraph 5 of the same chapter as follows:

"Unless absolutely necessary, the daily allowance of fresh water shall not be limited to less than one gallon per man for all purposes. When practicable, fresh water shall be issued for washing the soiled clothes of the crew."

Shoes are the most important single article of apparel worn and frequently are not given the consideration due them. Comfort and fit, not style, should influence their selection. The shoe should be large enough but not loose, wide enough to prevent cramping and turning in the toes, and the heel should be wide and not over one inch in height. Narrow shoes with pointed toes should never be worn, especially in a military service. Flatfoot is frequently caused by poorly fitting shoes. Low shoes are preferable to high ones in dry weather. Tight constriction around the ankle limits motion; tends to prevent the free return circulation of blood from the feet; and feet perspire more in high than in low shoes. Socks should be changed and washed daily. If the feet perspire

freely, a dusting powder should be used, or appropriate treatment sought at the sick bay.

Tight clothing which restricts the free movements of the body should not be worn during the period of development. Garters which are worn too tightly interfere with the circulation of blood in the legs and are apt to cause varicose veins. Belts hauled in too tightly restrict the proper abdominal movements and tend to cause constipation and hemorrhoids. Tight clothing over the chest prevents proper deep breathing, and a tight collar interferes with the return circulation of blood from the head, causing headaches. Tight clothing over any part of the body also interferes with the proper development of the muscles, and it is noticeable that those who wear high tight collars in early youth have undeveloped neck muscles.

Food.—Most people eat too much, especially of nitrogenous food, as meat, for example. When the body is overloaded with food one feels slow and heavy mentally and physically, an extra amount of energy is required to rid the body of the food, and it does more harm than good. Constipation, kidney irritation, and high blood-pressure are some of the consequences. The body has frequently, and quite aptly, been compared to a furnace in which the food as fuel is burned, thereby furnishing energy. Too much fuel smothers the fire, and if there is an accumulation of clinkers or ashes the efficiency of the furnace is impaired. This is comparable to constipation.

Meals should be eaten without haste, and food should be thoroughly masticated. The pernicious habit of bolting one's food is fairly common in the navy and ought to be corrected. It is a frequent cause of digestive disturbances.

The United States Navy Regulations, I 2618, paragraphs 2, 3, 4, and 5, relate to the inspection, care, preparation, and serving of food on board ship, as follows:

"A medical officer shall inspect, as to quality, all fresh

food purchased for the general mess, and frequently inspect the fruit and other articles of food and drink offered for sale alongside. In localities where night-soil is commonly used for fertilizing purposes, none of the vegetables ordinarily eaten uncooked shall be permitted on board and in infected ports no fresh milk, bottled waters, or fruits shall be allowed.

"When possible a junior officer and one or more petty officers shall be present when meals are served out at the galley; they shall report if there is any cause for complaint as to the quantity and quality of the food.

"The commanding officer shall establish hours for messing, having a due regard for the duties of the ship and the health of the crew. The crew shall not be disturbed during meal hours when it can be avoided. The practice of conducting visitors through the messing spaces of the men during meal hours should be discouraged. Meals shall not be served to men going on watch before the regular meal hours; such men shall get their meals at the regular time and shall relieve one-half hour after meals are served.

"The commanding officer shall see that all cooking and mess utensils are kept clean; that the food is wholesome and well cooked. Only pure water, distilled when practicable, shall be allowed for drinking or culinary purposes, and no water shall be issued for drinking until it has been examined and approved by the medical officer."

The navy ration is determined by law, and from this there can be no marked deviation. Thirty cents a day is the allowed cost of one ration per man. In the submarine service the allowance is sixty cents a day. This is necessary because of the peculiar duty performed by a submarine. When away from a tender or the base, mostly canned food is used because of the limited amount of stowage space, lack of refrigeration, and decreased facilities for preparation of meals.

The diet should be varied according to the climate, the size of the ship, and the duty which is being per-

formed. In the tropics less food should be eaten, especially meats. Fresh fruit, properly selected, should be an important item in the diet. On motor boats, patrol boats, submarines, and destroyers it is not always practicable to prepare the large meals possible on a battleship, and on these boats compactness, quickness and ease of preparation, digestibility, nutritive value, and variety should be the factors influencing the preparation of the food list.

Constipation.—Failure to evacuate the bowels thoroughly every day is harmful to the body. A perfectly healthy person ought to have two bowel movements a day. This will sound like an aggravated case of diarrhœa to those who have a bowel movement every second or third day, but unless the bowel is emptied there is absorption of poisons from the retained material, and this has injurious effects on the health. Regular visits to the water-closet, two times a day, should be cultivated, whether the desire is present or not. If one evacuation of the bowels does not occur in a day, a means of moving them should be sought. The drinking of a cup of hot water when the stomach is empty, as before turning in at night and upon arising in the morning, is a splendid means of preventing constipation. The liberal eating of fruits and vegetables, and exercise, especially of the abdominal muscles, are valuable preventive measures. Laxatives or purges should be taken only when prescribed by the medical officer.

Exercise.—Some form of exercise in the open air should be taken daily. A large percentage of the common minor ailments is due directly or indirectly to lack of exercise under favorable conditions and to eating too much food. To be beneficial, exercise must be stopped short of the point of fatigue, and a sense of exhilaration, not exhaustion, should follow. Exercise should not be taken immediately preceding or following a meal.

Physical training consists of appropriate exercise under intelligent supervision. It aims to build up healthy and vigorous constitutions and to maintain bodily health

and mental vigor. It is desirable to gain health and not strength by exercise, for there is a difference between health and strength. One may be large, muscular, and apparently very strong, and yet not healthy, for the heart, lungs, or kidneys may not be in good condition. Health is freedom from disease and a condition in which the resistance of the body against disease is strong and able to withstand successfully attacks of germs, even under the stress of hardship, strenuous duty, and other unfavorable conditions. General symmetrical development should be cultivated rather than the overdevelopment of certain groups of muscles at the expense of others.

Exercise also establishes a proper balance between mind and body. Men whose profession or work requires severe mental strain, and who have little or no inclination or desire to engage in any healthful outdoor exercise, frequently become either thin, sallow, nervous, and irritable, or very fat, soft, and sluggish mentally and physically. These men fail in health not because they are slaves to their work but because they do not exercise.

Athletics are encouraged in the navy. Competition stimulates interest in any field of human endeavor, and especially so in athletics. Men meet in stern but friendly rivalry in the various branches of sport, their muscles swelling, their lungs expanding with the fresh air, and they are benefited by it. The determination to win fairly, the period of training preliminary to the contest, the denial and self-discipline, the ability to be a good winner, and, what is better, a good loser, all help to develop character.

Article 2620, paragraph 1, U. S. N. I., relating to athletics in the navy, reads:

"The commanding officer shall encourage the men to engage in athletics, fencing, boxing, boating, and other similar sports and exercises. Gymnastic outfits will be furnished by the department to vessels requesting them. When the weather and other circumstances permit, he shall establish in the routine of exercises and drills a regular period for swimming, such exercise to include

every enlisted person on board, except those excused by the surgeon."

SHIP HYGIENE

A clean ship is a healthy ship. The cleanliness of a ship is an index to her efficiency and the happiness of her crew. Much stress is, and ought to be, laid on the necessity for the most scrupulous cleanliness of the men and the ship in Article 2617, U. S. N. I.:

"So far as possible, the ship shall be kept thoroughly clean throughout, dry, at a comfortable temperature, well supplied with light, and properly ventilated; blowers shall generally be kept running at full speed when hammocks are down. The men shall be required to wash daily; when possible, supplies of fresh water shall be allowed for that purpose and for washing clothes. Barrels or buckets of dirty water must not be stowed away or permitted to stand about the decks. Bath and wash rooms shall be supplied with hot and cold water and kept open during the evening. Every effort shall be made to encourage cleanly personal habits. The hair and beard shall be kept short. At morning inspection division officers shall carefully observe whether these rules have been followed, and, should it be necessary, any man may be punished for their infraction."

Ventilation.—The ventilation of a ship consists of the systematic renewal of the contained air, thereby supplying the necessary oxygen, and at the same time ridding the ship of carbon dioxide, odors, and other contaminating substances which are the products of respiration and man's occupancy. The important factors in ventilation are the proper degree of temperature and humidity, freshness, and motion of the air. Men whose duties keep them below should go on deck when off watch so that they will get as much fresh air as possible. A constant supply of fresh air in sleeping compartments at night is necessary, and care should be taken that men whose hammocks are swung near ventilator terminals do not close them. In the fire-rooms a steady stream of fresh air is needed not

only for the engines but to reduce the temperature of the air and prevent excessive humidity. Air in motion, even when foul, hot, or humid, is not as depressing as still air.

The ventilation of submarine boats is of even greater importance than the ventilation of the battleships. When running on the surface, except in the very smoothest water, all hatches, except the conning-tower hatch, have to be closed to prevent water getting into the boat. The current of air down this hatch is drawn aft to the engine-room, and, unless the forward ventilator is shipped, or air is directed to the forward compartment by means of air ducts or electric fans, the ventilation in that compartment is very poor.

Before starting on a submerged run care should be exercised that the initial air in the boat is fresh and free from contamination. The average oxygen consumption of one man per hour has been estimated at about 0.9 cubic foot, while the average CO_2 output per man per hour in a submarine is about 0.7 cubic foot. Under submerged conditions it is known that the CO_2 output is relatively increased and the amount of O consumed is greater than the amount ordinarily used by men breathing fresh air, especially after the boat has been submerged for some time. Knowing the net cubic air content of the boat, it will not be difficult to estimate that the initial supply of air will not be adequate for the health and comfort of the crew after a few hours. Pure, dry air contains about 20 per cent. oxygen and 0.04 per cent. carbon dioxide, and the limits to which oxygen may fall and carbon dioxide rise without seriously interfering with the health of a submarine crew are respectively 15 per cent. and 3 per cent. To prevent excessive vitiation of the contained air various schemes of air renewal or air washing have been tried. On the German submarines a system of air washing, in which the air is passed through cylinders of KOH to remove the carbon dioxide and battery gases, gives good results. Oxygen is added to the air to replace that which has been used in respiration.

Odors from cooking food, and gases from the battery, also contaminate the air in a submarine. The humidity and the motion of the air are important. An electric fan to keep the air in motion is a necessity in each compartment.

Drinking Water.—Distilled water is used for drinking and culinary purposes on practically all ships of the navy. There is little chance of contamination unless the evaporators or distillers are not in good working order, or the tanks are unclean. The water should be tested frequently for the presence of salt and other impurities, and the tanks inspected to insure their cleanliness. Under certain conditions it may not be practicable to distil water on board ship, and this circumstance is covered by the Naval Regulations, I, 2112:

"Before cooking or drinking water from shore is taken on board, the medical officer shall investigate its source and make as complete an examination of it as possible with the means at hand, and report at once if any doubt exists as to its purity. All such examinations shall be recorded in the journal."

At sea salt water is used for washing down the decks, but "in ports where cholera, typhoid, dysentery, or other water-borne diseases are prevailing, either sporadically or epidemically, the use of harbor water shall not be permitted on board, either upon or below the upper deck; also, in ports where the water is contaminated by sewage, animal matter, or refuse, its use shall only be permitted after consultation with the medical officer of the ship."

Disposal of Refuse.—Garbage is thrown overboard at sea; boxes and barrels are broken up and burned, and metal cans are crushed or pierced before being thrown overboard to prevent their floating. Garbage and waste materials should never be dumped overboard in a closed harbor, but should be disposed of in garbage cans, if the ship is alongside the dock. A lighter should remove all refuse.

"*In confined* ports, where garbage would constitute

a menace to the health or a nuisance to the people in the vicinity, it shall not be thrown overboard, but shall be burned on board ship or otherwise disposed of in some suitable manner."—Article 2632 (2), U. S. N. I.

Barber Shop.—A clean, sanitary barber shop is a necessity aboard ship. Frequent inspections are necessary. A careless barber in an unclean shop may be a prolific spreader of disease.

Heads (Water-closets).—The seats in the heads should be scrubbed and, if practicable, exposed to the sunlight every day. Heads should be free from odor; if not, there is undoubtedly some defect in the ventilation or cleanliness. In the submarines, motor boats, and vessels in general, the head should be as far removed from the galley as possible. It should be screened, especially in warm weather.

The Galley.—The galley is an important part of the ship, and absolute cleanliness of all utensils, of the cooks and their uniforms, as well as the food, is of the utmost importance. The cooks, stewards, and mess attendants should be regularly and frequently examined by the medical officer, and any communicable disease or infection should be cause for immediate removal of the man from his duties. None but clean and healthy men should handle food. Lack of cleanliness in the galley may be responsible for illness in the crew. Particles of food lying about attract flies, bugs, and rats, and should be cleaned up and deposited in the garbage cans. The galley should be screened.

General Hygienic Considerations.—In cruising about, infected ports should be avoided when possible. The anchorage in ports where mosquitoes are prevalent should be to windward of mosquito-breeding districts and at least one mile away. The ship should be screened, especially if malaria, yellow fever, or dengue is prevalent in the vicinity, and all officers and men should sleep under mosquito netting.

If smallpox is prevalent, every person on board who

has not had a successful vaccination within one year should be vaccinated. The anti-typhoid inoculation should be administered once every four years.

Article 952, U. S. N. I., is of interest in this connection:

"The Commander-in-Chief shall take every reasonable precaution to preserve the health of crews of ships serving in malarial and unhealthful regions. When in unhealthful localities, and where necessary, native boatmen may be employed to attend the ship, in order to preserve the health of the crew.

"Upon arrival in port, he shall at once obtain information regarding the health of the neighborhood, and in case of prevalence of infectious disease the Commander-in-Chief shall consult with the fleet surgeon and adopt such of the following precautionary measures as are consistent with the necessities of the ship and the exigencies of the service:

"'(*a*) Restriction of liberty on shore, either to certain hours or to the transaction of important business; when necessary, total deprivation of liberty.

"'(*b*) Restriction of communication with the shore or other ships, either to market boat, mail boat, or chartered boat; when necessary, complete non-intercourse.

"'(*c*) Restriction of supplies (food, water, coal, and other stores) from shore.

"'(*d*) Modification of standing orders or routine regarding drill, dress, diet, etc., for the crew, and the ventilation and purification of the ship or any of its parts.

"'(*e*) Control of any other conditions likely to affect the general health of the ship.'

"In tropical climates, and especially in unhealthful ports, ships shall be kept as cool and dry as possible. Awnings shall be kept either spread or housed."

The sanitary scuttle butt or bubbling well drinking fountain should be on all ships, but on ships not so provided, the drinking cup should be immersed in a bucket of *formalin* solution (1 to 2000). The medical depart-

ment should see that the bucket is supplied with the solution, and that cleanliness is maintained.

Artificial illumination between decks should be provided for the crew. It should be of sufficient brilliancy to prevent eyestrain. "During rainy or cloudy weather, and at other times, if necessary, when the duties of the ship will permit, sufficient artificial light shall be supplied between decks for the crew to read, write, or engage in recreation."—Article 2607 (8), U. S. N. I.

CAMP HYGIENE

Landing parties and expeditions are of frequent occurrence in the navy, hence a knowledge of camp hygiene is a necessity. There are more dangers, from a sanitary point of view, in a camp than on board ship. Only those men who are physically fit should be selected for duty with a landing force. Men afflicted with venereal disease, deformed feet, obesity, or those whose strength is not up to par, should not be taken.

The selection of the camping site is important, and is made by the commanding officer upon the recommendation of the medical officer. The ideal site is upon elevated ground, to windward of mosquito-breeding marshes, and with good natural drainage. Living in tents is preferable to the occupation of old buildings, for the latter may contain disease-breeding germs from former occupancy, and for the same reason, except in cases of urgent necessity, no camp should be pitched upon the site of a former camp unless it has been thoroughly cleaned.

Insects, such as flies and mosquitoes, are a grave menace to the health and comfort of the men in camp. Mosquitoes transmit malaria, yellow fever, and dengue; flies carry the causative germs of typhoid fever and dysentery. The bites of sand-flies and ticks cause great discomfort. The camp should be removed as far as practicable from mosquito-breeding places, and each officer and man should sleep under mosquito netting.

Men on sentry duty at night in a camp where mosquitoes are prevalent should anoint the exposed portions

of the body with oil of citronella mixture and wear head nets. The periodic administration of doses of quinine as a prophylactic against malaria is of value. The destruction of mosquito-breeding places consists of filling in pools of stagnant water, or, if that is not practicable, covering the surface of the water with oil; the crushing or burial of all tin cans, the destruction of all bottles and empty barrels, so that water cannot collect in them and thus afford a breeding place for mosquitoes. Kitchens should be screened and all refuse material collected in garbage cans which are covered or screened, and burned at least once daily.

The latrines should be so located that they will be at some distance from the camp and kitchens, and as far as practicable from the water supply, so that the wind will not carry dust or flies in that direction, and also that the water may not become contaminated. As soon as the camp is located the site for the latrines should be selected and the pits dug. The men should not use any other place than the one designated. The pits are about two feet wide, twelve to fifteen feet long, and from five to ten feet deep, the depth depending upon the probable length of stay. Seats and covers are necessary if the camp is to be used for any length of time. The earth removed when the pits are dug should be thrown to the rear and later used to sprinkle over the contents. Hay, straw, or paper saturated with oil or kerosene should be burned in the pit, if practicable, once a day. Chloride of lime sprinkled over the sides and bottom is an effective deodorizer. These measures tend to discourage the approach of flies, diminish disagreeable odors, and prevent the spread of disease in the camp. Pits should be covered with earth and marked when the camp is abandoned.

Water for drinking, cooking, and washing dishes should be boiled. This rule ought to be followed religiously. Water from streams or wells may have all the *physical* characteristics of good water and yet be con*taminated with* the germs of typhoid fever or dysentery.

The water supply of a camp should be examined, if practicable, by the medical officer, and, if found to be free from chemical and bacteriological impurities, can be used without boiling or chemical purification. This examination is not always possible, however, and it is better to be on the safe side and always boil it. The addition of calcium hypochlorite, one gramme to forty gallons of water, will destroy all germs in about half an hour. This method of purification can be used when it is not practicable to boil the water.

Food should be protected against contamination on the march, while it is being prepared and when served. The cooks ought to be thoroughly instructed regarding the necessity of cleanliness in kitchen utensils, the protection of food against flies, the use of boiled water in the preparation of food and in washing dishes, the thorough cooking of food, and how to serve it in the most appetizing manner. Food should be inspected before and after cooking. Unboiled milk and the various "soft drinks" are dangerous, as are also unripe fruits, salads, and raw foods in the tropics. Fresh, ripe, and clean fruits are beneficial, but care must be used in their selection in tropical countries, especially where cholera or dysentery is prevalent. In the tropics the amount of food, especially meats, should be reduced. The juice of oranges, lemons, or limes is healthful, and plenty of water should be drunk between meals. The use of alcoholic beverages is especially harmful. The common drinking cup is an unhygienic relic of the past; individual cups should be used.

Clothing suitable to the weather should be worn. Men's heads should be protected from the direct rays of the sun. Men should not lie down on the bare ground at night, nor should they sleep in damp clothes. Pneumonia may result from neglect of these precautions, especially where there is great difference between day and night temperature and in localities where there are heavy dews at night. Wet clothing is not harmful so long as the men are exercising, but after the day's march

or when the activity has ceased the wet clothes should be removed, the body bathed or rubbed with a rough towel, and dry clothing donned.

Activity during the heated hours about midday in the tropics should be reduced or avoided if possible. Drills or exercises are best done before ten o'clock in the morning and after four o'clock in the afternoon.

The care of the feet on the march is of prime importance. Shoes should be of the proper size and shape. This has been discussed in the paragraph on "Clothing" under the heading of "Personal Hygiene." Socks should be free from holes and made of cotton wool of moderate thickness. These absorb perspiration, holes are not worn in them easily, and therefore the liability of blisters is lessened. As soon as possible after the march the shoes and socks should be removed, the feet washed, and fresh, clean socks put on. Excessive perspiration is remedied by dusting in the socks and shoes a powder consisting of equal parts of boric acid and powdered alum. Any ailment or injury of the feet, no matter how trivial, should not be regarded lightly, and treatment should be sought at the hospital tent as soon as practicable. Neglect of the feet and failure to report for treatment of even minor ailments thereof should be considered an infraction of discipline.

The importance of hygiene to any military force, ashore or afloat, is so great that no commanding officer can afford to overlook it. Its importance is noted in Article 2044, U. S. Naval Regulations:

"The commanding officer of a ship shall use all proper means to preserve the health of the crew, and shall, from time to time, consult with the medical officer of the ship in regard to sanitary measures to be adopted for that end."

More casualties in war have been caused by preventable disease and lack of hygiene than by bullets. Any great military power that appreciates the value of its soldiers and sailors takes the greatest pains to instruct them *thoroughly* in simple rules of hygiene.

CHAPTER XXXVI

THE NAVY AS A CAREER

THE life of a sailor—and particularly the life of a man-of-war's-man—with its adventures, ever-changing scenes, new countries, new people; following the sea from port to port, from one ocean to another, has always appealed strongly to the imagination of men of spirit. In the record of the deeds of the men of the United States Navy, from John Paul Jones to Admiral Dewey, the young American can find the highest inspiration; for our navy, both in time of war and of peace, has played a great, honorable, and often glorious part in the history of the country. The navy has been, throughout its entire existence, a service of high ideals; and its unbroken record of great and worthy achievement, of duty well done, has been due to the high standard set for officers and men in the beginning and maintained ever since. But, in addition to the chance of serving the country in an honorable position, a place in the navy offers, as a livelihood, many advantages—such as steady employment; good, practical training; gradual promotion; provision for old age; a healthful life; an opportunity for travel and education. The pay is graded according to a man's skill and length of service, and compares favorably with that of highly-paid labor in civil life.

In addition to pay, each enlisted man is fed by the Government, so that the pay is clear money.

A man, to enlist, must first show that he is up to the requirements of the navy—in character, in physique, in education, and in ability. He must earn his advancement; if he is without skill or experience in any trade, he must (and should) be willing to start at the bottom and work up a grade at a time—as thousands of others like him have done.

An enlisted man in the navy is always sure of his employment so long as he renders faithful service and continuously qualifies himself for higher duty by diligently performing the tasks set him. He cannot be thrown out of work because of strikes or hard times. World disarmament alone can affect him. If he is sick or injured, he is well cared for in a modern naval hospital. His pay goes on whether he be sick or well. He has no doctor bills for himself. Upon completing an enlistment, if his record has been meritorious, he receives, as a testimonial of fidelity and obedience, an honorable discharge; this entitles him to reënlist at any time within four months, if he is physically qualified, and to get four months' pay as a bonus for reënlistment. If he is disqualified for rënlistment by reason of disability incurred in line of duty, he is entitled to a pension.

As a principle, the navy desires those only who are willing to strive for continuous advancement to reënlist. The man who has served four years, even with a good record, but who has not been promoted in that time to a petty officer, is usually defective in ambition or else he is stupid, and the navy has no place for stupid men.

The navy has two important services to perform in the question of enlisted personnel.

(*a*) It must educate and train men to become petty officers in the navy, these to be more or less permanent, and adopt the navy as their career. Many of these will become chief petty officers, warrant officers, and commissioned officers.

(*b*) It must educate and train a vast number of young men in the duties of a sailor. These young men, unless they show especial aptitude after being trained, are no longer required in the navy. Having been trained for one, two, three, or four years, they become valuable men for the reserve, and, as the total number of enlisted men is fixed by law, upon the discharge of a trained man a recruit can at once be enlisted. In this way there will be made many hundreds of thousands of young men who

have undergone naval training. In war all of these men will be called back to service. Remember, the enlisted total of the British Navy upon the outbreak of this war was about 125,000; now there are nearly 400,000 men serving afloat or ashore in that navy.

Napoleon was fond of saying that soldiers fought on their "belly." He meant that in order to do good work both the mind and the body must be properly nourished by good and wholesome food in sufficient quantities. This applies not only in war but in peace. Overfeeding is as bad, however, as underfeeding. The navy does not overfeed, for there is always plenty of interesting work to be done which keeps the digestive system in prime order. The food in the navy is excellent. Great care is taken to provide it of the very best quality and in quantities sufficient so that there is no danger of any man going hungry.

The purchasing, preparing, cooking, and serving are done under the inspection of commissary officers of the navy, who are required to see that the food is appetizing and nourishing. The character of the diet is changed with the seasons of the year and the climatic conditions of the locality in which the ship cruises, but, whenever possible, the sailors are supplied with fresh provisions. It is believed that the U. S. Navy ration is better than that of any other military service in the world.

This subsistence is furnished to enlisted men free. They have no board-bills to pay when on duty.

It is said that no man can consider himself truly educated unless he has travelled. To live always in one environment, even in such a great city as New York, tends to narrow the outlook of an individual. A man who has not travelled is said to be provincial. The broadening effect of seeing the world, of associating with men of other nations, of observing how other races live, is strikingly evident in our sailors. It puts their own country in a new perspective. They see its many faults and how much behind it is in certain particulars, especially the

military features, but they learn to love it more. To a sailor the United States becomes "God's country," and after several years in foreign ports, when the whistle pipes and the hoarse-throated boatswain mates call "All hands, up anchor for home!" a little spiny shiver goes up the back and a catch comes in the throat of every sailorman on board.

Vessels of the United States Navy are employed in all parts of the world. The opportunities afforded for travelling are wonderful and at no expense.

While no promise can be made a recruit that he will be given any particular cruise, the duties of the navy call for frequent foreign cruises, and it is safe to say that, during the course of an enlistment, a man will have a chance to visit many out-of-the-way places which he could not possibly visit otherwise.

Cruises to European ports are rarer than they were ten years ago. The reason is that most of our warships are battleships, and all the battleships are kept concentrated in one great fleet. This is a requirement of naval strategy which cannot be violated simply to gratify the desire to travel.

After the war in Europe is over there doubtless will be American warships sent to cruise in European waters for the purpose of protecting our interests and looking out for our citizens.

Our navy is a sea-going navy. It rarely stays long in one port, unless in reserve or under overhaul; and it is a busy navy. The most important part of the navy is the Atlantic Fleet. During the winter months this fleet assembles in West Indian waters, where drills and manœuvres are held. The fleet bases at Guantanamo, Cuba, a beautiful sheet of water, ideal for all manner of aquatic sports. While at Guantanamo each man is required to pass through the rifle practice course on the Guantanamo rifle range, said to be the largest in the world.

As "all work and no play makes Jack a dull boy," *when work* is done play begins.

Baseball games are played daily, boat races are pulled off in the waters of the bay, minstrel shows are staged, and athletic events of all kinds are of frequent occurrence. The ships of the fleet are provided with the latest moving-picture machines and films, and every battleship has its own band.

With the approach of spring the fleet returns north to home ports, and liberal shore-leave is granted whenever practicable. During the summer the fleet manœuvres off the Atlantic coast of the United States, where war games are played and target practice is held.

The men of the Pacific and Asiatic Fleets are similarly employed, and also are given opportunities for recreation like those given men of the Atlantic Fleet.

Cruises are made, either by vessels acting singly or in squadrons, to the Philippines, Hawaii, and other islands of the Pacific, along the coast of China, and to Japan, frequently; to South American, Mediterranean, and African ports, occasionally.

The navy is its own school. It has need for many trades, and is willing to take a man without any technical education, with only the will to learn, and make him a useful sailorman.

There are four large training stations: at Newport, R. I.; Norfolk, Va.; Great Lakes, Ill. (north of Chicago), and San Francisco, Cal. Every recruit who enlists as apprentice-seaman is immediately transferred to one of these training stations for instruction before he is assigned to a seagoing vessel. Young men, between seventeen and twenty-five, who are unskilled in any trade are sent to the training stations.

From these youths, many of them with considerable academic education, the petty officer ranks are filled, and a few of the most ambitious are wearing commissioned officers' uniform, and a greater number are serving as warrant officers.

For the benefit of men who enter the navy with some

knowledge of or experience in a trade or special vocation, the navy maintains trade-schools, as follows:

The Navy Electrical School, for the instruction of electricians, both general and radio; the Artificer School, for shipwrights, shipfitters, carpenters, blacksmiths, painters, etc.; the Yeoman School, for stenographers, typewriters, and bookkeepers; the Commissary School, for cooks, bakers, and commissary stewards; the Hospital-Corps Training-Schools for the instruction of men in nursing, first-aid, drugs, etc.; the Coppersmith School; the Machinist School; the Aeronautic School; the Musician School; the School for Diving; the Torpedo School, and the class for the instruction of gasoline engines.

Not all of these trade schools are open to men on their first enlistment. Some, such as the machinists' school and the torpedo school, are open only to men of good record upon reënlistment. All the schools are conducted, however, for the benefit of enlisted men of the navy who desire to fit themselves for more responsible duty and better pay. In most instances the training obtained in these schools will stand the men in good stead in civil life, should they decide not to follow the navy as a career. Former enlisted men of the navy, who owe their success to the training they received while in the navy, may be found in nearly every large industry, holding enviable positions. They look back upon the navy as does a college man to his "Alma Mater," and in case of national need would willingly throw up their well-paying positions and answer the call of their country.

In addition to the practical instruction imparted at the training stations and in the navy trade-schools, a course of academic instruction is conducted throughout the naval service. Every recruit is examined as to his educational needs, and if he is deficient in any common-school studies he is assigned to such classes as will supply the education he lacks. The academic instruction does not stop at the training stations, but continues on board

ship; and if a young man shows a willingness to advance himself, he is given every encouragement and is afforded an opportunity to demonstrate his ability.

It is fundamental that knowledge must be the foundation upon which success in the navy is constructed. Without knowledge a man can get nowhere. This academic education is not forced upon the man who does not desire it; but all advancement above a limited amount consequent upon his technical ability is barred to him unless he has knowledge.

When a man enlists in the navy, his name is immediately placed upon the payroll; but if he enlists as an apprentice-seaman, he does not draw all his pay for any month during the training period. However, the pay that is withheld is given him at the time he completes his course of instruction. Thereafter he draws all the pay due him each month. Paydays in the navy occur twice a month, on the 5th and 20th.

Each recruit is provided free with an outfit of uniform clothing, bedding, and other necessaries, amounting to $60. This outfit includes, among other things, woollen blankets, jack-knife, handkerchiefs, tooth-brushes, hair-brushes, scrub-brushes, shoe-polish, mattress and mattress-cover, handkerchief, high and low shoes, spools of cotton, silk, and linen thread; all articles of uniform for summer and winter, including overcoat, sweater, gloves, bathing trunks, and gymnasium shoes. All this outfit is not issued at once, but only so much of it is furnished the recruit as the season requires; for instance, if he enlists in midsummer he will be issued a white uniform and one set of "blues," but no overcoat or sweater. If he enters the service in midwinter the summer weight of underwear and white clothes will remain to his credit to be drawn when needed. The outfit is complete in all respects and is ample for the needs of the recruit during his first year of service; and if he is reasonably careful of his clothes many of the articles need not be replaced for three or four years.

A recruit is taught how to mark his clothes so that they will not be lost. Civilian clothes must be disposed of and they can either be sent home or be given away at the station.

When a man enlists he is furnished by the Government with transportation to the training-station or to the receiving ship to which he is assigned; and if there is a night ride he is given a berth in the sleeper or a stateroom, if sent by steamer. While on the way meals are furnished by the Government, as are carfare, transfers across the city, etc. When a man is discharged at the expiration of his enlistment, he is furnished with a "travel allowance," at 4 cents a mile, instead of transportation, from the place of discharge (if in the United States) to the place of enlistment, within the United States. If he is discharged before his enlistment expires, by reason of physical disability, he is furnished with transportation and subsistence to his home, if in the United States. Men travelling under orders are always furnished with transportation and expenses. It is only when a man is travelling at his own convenience, or on leave, that he is required to pay his own expenses.

There are many different rates of pay in the navy, and a man enlisting in one of the lower ratings is advanced one step at a time, with a corresponding raise in pay, as he becomes proficient and his conduct warrants, both of which requirements are essential to a man's advancement in the navy; and no matter how capable he may be in his duties, he cannot expect to be advanced unless his conduct entitles him to consideration.

The pay of an apprentice-seaman is $17.60 a month. The first raise in pay in the seaman branch is $20.90; and, in the fire-room, to $24.20. These increases are made at the time the recruits qualify at the training-station and before they are sent to sea. Subsequent advancement is obtained after the man has been assigned to general service and depends to some extent upon existing vacancies. In the seaman branch, the first rating

obtainable on board ship is that of seaman, \$26.40. A seaman is eligible for advancement to third-class petty officer (coxswain, gunner's mate, third class, quartermaster, third class) at \$33 per month. Petty officers second class of the same seaman branch are paid \$38.50 a month. Petty officers first class are paid \$44, except turret captain first class, who receives \$55. Chief petty officers of the seaman branch are paid from \$55 and \$66 for acting appointment to \$77 for a permanent appointment, which is issued only after a year's service as chief petty officer and after examination before a board of officers.

In the artificer branch, the pay of seagoing ratings ranges from \$24.20 to \$77 for a chief petty officer with a permanent appointment.

In the special branch—which includes yeomen, musicians, and the hospital corps—the pay ranges from \$17.60 for the recruit to \$77 for chief petty officers with permanent appointment.

The commissary branch is composed of ship's cooks, bakers, and commissary stewards, with pay ranging from \$17.60 for the recruit (landsman for cook or baker) to \$77 for chief commissary steward.

The messman branch is composed of men whose duty it is to buy, prepare, cook and serve food for the officers, the ratings being cabin stewards, cabin cooks, wardroom stewards, wardroom cooks, warrant officers' stewards, warrant officers' cooks, stewards and cooks for commanders-in-chief and for commandants, and mess attendants, first, second, and third class. The pay ranges from \$22 a month, for mess attendant third class, to \$66 for stewards to commanders-in-chief.

The pay of the various ratings is set forth in the following tables, this pay being what is known as "base pay," or the navy pay without allowances for reënlistment, continuous service, good conduct medals, or special duty—all of which are explained later:

NAVY PAY TABLE

Chief Petty Officers

Seaman branch	Monthly pay	Artificer branch	Monthly pay	Special branch	Monthly pay
Chief masters-at-arms	$71.50	Chief machinist's mates	$77.00	Chief yeomen	$66.00
Chief boatswain's mates	55.00	Chief electricians	66.00	Hospital stewards	66.00
Chief gunner's mates	55.00	Chief carpenter's mates	55.00	Bandmasters	57.20
Chief turret captains	66.00	Chief water tenders	55.00		
Chief quartermasters	55.00				

All chief petty officers with a permanent appointment receive $77 a month and allowances.

Petty Officers, First Class

Seaman branch	Monthly pay	Artificer branch	Monthly pay	Special branch	Monthly pay
Masters-at-arms, first class	$44.00	Boilermakers	$71.50	Yeomen, first class	$44.00
Boatswain's mates, first class	44.00	Machinist's mates, first class	60.50	First musicians	39.60
Gunner's mates, first class	44.00	Coppersmiths	60.50		
Turret captains, first class	55.00	Shipfitters, first class	60.50		
Quartermasters, first class	44.00	Electricians, first class	55.00		
		Blacksmiths	55.00		
		Plumbers and fitters	49.50		
		Sailmaker's mates	44.00		
		Carpenter s mates, first class	44.00		
		Water tenders	44.00		
		Painters, first class	44.00		

NAVY PAY TABLE—*Continued.*

Petty Officers, Third Class

Seaman branch	Monthly pay	Artificer branch	Monthly pay	Special branch	Monthly pay
Masters-at-arms, third class	$33.00	Electricians, third class	$33.00	Yeomen, third class	$33.00
Coxswains	33.00	Carpenter's mates, third class	33.00	Hospital apprentice, first class	33.00
Gunner's mates, third class	33.00	Painters, third class	33.00		
Quartermasters, third class	33.00				

Seamen, First Class

Seamen gunners	$28.60	Firemen, first class	$38.50	Musicians, first class	$35.20
Seamen	26.40				

Seamen, Second Class

Ordinary seamen	$20.90	Firemen, second class	$33.00	Musicians, second class	$33.00
		Shipwrights	27.50	Buglers	33.00
				Hospital apprentices	22.00

Seamen, Third Class

Apprentice seamen	$17.60	Coal passers	$24.20	Landsmen	$17.60

Commissary Branch

	Monthly pay		Monthly pay
Chief commissary steward	$77.00	Ship's cook, fourth class	$27.50
Commissary steward	66.00	Baker, first class	49.50
Ship's cook, first class	60.50	Baker, second class	38.50
Ship's cook, second class	44.00	Landsmen	17.60
Ship's cook, third class	33.00		

NAVY PAY TABLE—*Continued*

Messman Branch

	Monthly pay		Monthly pay
Stewards to commanders-in-chief	$66.00	Steerage stewards	$38.50
Cooks to commanders-in-chief	55.00	Steerage cooks	33.00
Stewards to commandants	66.00	Warrant officers' stewards	38.50
Cooks to commandants	55.00	Warrant officers' cooks	33.00
Cabin stewards	55.00	Mess attendants, first class *	33.00
Cabin cooks	49.50	Mess attendants, second class *	27.50
Wardroom stewards	55.00	Mess attendants, third class *	22.00
Wardroom cooks	49.50		

*If American citizens.

All stewards and cooks of the messman branch who are American citizens and hold certificates of qualification receive $5.50 a month in addition to the above rates of pay.

In order to obtain all the benefits of continuous service, a man must reënlist within four months after the date of his honorable discharge. He can reënlist the next day, or remain out of service for four months; but if he reënlists within four months, he receives a bounty of four months' pay at the rate he was paid on discharge. Upon reënlistment, his pay is increased by $1.50 for honorable discharge. In addition, and as a compensation for a trained man, and regardless of whether his service is continuous, his pay is increased by a further sum of $5.50 per month for the first reënlistment, and by $3.30 per month for each subsequent reënlistment.

Further, if he is recommended by his captain, he is awarded a Good Conduct Medal after the first reënlistment, and a Good Conduct Bar on each subsequent reënlistment. The holder of a Good Conduct Medal, Pin, or Bar is entitled to 82 cents a month for each medal, pin,

or bar he possesses, for all his subsequent enlistments that are continuous. These payments accumulate with each enlistment. Thus it will be seen that, on second continuous enlistment, the pay of any rating or branch of the service is increased by $7 per month; on the third enlistment the pay is further increased by $5.62, and so on through his naval career.

Men who reënlist within four months from the date of their honorable discharge may, under certain conditions, be detailed to a course of instruction in the Seaman-Gunner's School. A certificate of graduation from this school entitles the holder to $2 a month additional to his pay.

Coxswains of boats propelled by machinery, coxswains to commanders-in-chief, seamen in charge of holds, men regularly detailed as crew messmen, men assigned to duty as jack-of-the-dust and as lamp-lighter, all receive $5 a month in addition to their other pay.

Enlisted men regularly detailed by the commanding officer as gun captains, excepting secondary-battery guns, shall receive in addition to their regular pay $5 a month.

Men regularly detailed as signalmen shall receive extra compensation as follows: Signalmen, first class, $3; second class, $2; third class, $1.

Enlisted men who are detailed for aviation duty involving actual flying in aircraft receive 50 per cent. increase in pay and allowances of their rating.

Five dollars a month is allowed each man serving on board a submarine vessel, in addition to his regular pay. He is besides allowed $1 additional for each day the submarine is submerged while under way, provided it does not amount to more than $15 in any one month.

A man employed in submarine diving, and not under instruction, or diving for practice, receives extra pay at the rate of $1.20 an hour for the actual time so employed under water.

Enlisted men who qualify as gun pointers and who are

regularly detailed by the commanding officer receive the following additional monthly pay:

Heavy-gun pointers (for guns of 8-inch calibre or larger):	
First class	$10
Second class	6
Intermediate gun-pointers (for 4-inch to 7-inch guns):	
First class	8
Second class	4
Secondary-gun pointers (for guns from 1-pounder to 3-inch):	
First class	4
Second class	2

Gunnery prizes are awarded to the members of meritorious gun and torpedo crews in three classes, viz.: First class, $20; second class, $10; and third class, $5 per man. The members of winning turret, gun, and torpedo crews are also awarded the right to wear the navy "E," signifying excellent.

An enlisted man detailed as "ship's tailor" on board of a vessel having a complement of 600 men or more, exclusive of marines, shall receive $20 per month in addition to the monthly pay of his rating; on a vessel having a complement of 300 to 600 men, $15 per month additional; on a vessel having a complement of less than 300 men, $10 per month additional. An enlisted man detailed as a "tailor's helper" in a vessel having a complement of 600 men or more receives $10 per month in addition to his monthly pay: *Provided,* That the total pay of "ship's tailor" shall not exceed $50 per month, and of "tailor's helper" $40 per month.

Men detailed as navy mail clerks receive in addition to their other pay $30, $25, $20, and $10 a month, depending upon the size of the crew of the vessel or flotilla. Men detailed as assistant navy mail clerks receive $15 a month in addition to the pay of their rating.

The law provides for the appointment each year of 15* enlisted men to the Naval Academy, the requirements being that the applicant must pass a competitive examina-

* *Recently increased.*

tion, must be under twenty years of age at the time of appointment, and must have been in the navy at least one year at date of entrance to the Naval Academy. Examinations for entrance to the Naval Academy are conducted on board all ships and stations wherever there are applicants. In order to give young men a chance to prepare for this examination, classes are formed at all the training stations (and on board ships), with special instructors and the free use of the necessary text-books. The candidates who have the highest standing on the examination enter the Naval Academy on August 15, and are admitted on exactly the same terms as midshipmen who are nominated by Members of Congress.

For those young men who cannot depend upon obtaining a nomination for the Naval Academy through a Member of Congress, this gives an opening. The year in the navy as an enlisted man should be found of special benefit and should give the young man considerable experience which will put him in the forefront among those who have not served in the navy previously. Of course, there must be no lack of academic education, for the course at the Naval Academy is competitive and those found deficient in studies are summarily dropped.

Advancement in the navy does not stop with chief petty officer. The next higher grade is that of warrant officer, which is a life position, attainable only by promotion from enlisted grades. The pay of a warrant officer is from $1500 to $2400 a year, depending upon length of service, with benefits of retirement at sixty-four years of age on three-quarters pay, or at any time before sixty-four for disability incurred in line of duty. The warrant officer grade is composed of boatswain, gunners, carpenters, machinists, pharmacists and pay clerks. The qualifications for appointment are as follows:

Boatswains are appointed from among candidates of the seaman branch under thirty-five years of age, who have served at sea at least seven years, have attained the rating of chief or first-class petty officer, with an average

mark on their enlistment record of not less than 85 per cent., and are serving continuously.

Gunners are divided into three classes: Ordnance, electrical, and radio. Candidates must be under thirty-five years of age, with an average mark of not less than 85 per cent. and serving as chief or first-class gunner's mate, turret captain, or electrician.

Carpenters are appointed from among candidates of the artificer branch, under thirty-five years of age, with an average mark of more than 85 per cent., and serving continuously as chief or first-class petty officer.

Machinists are appointed from among candidates of the engineer branch, under thirty-five years of age, with an average mark of more than 85 per cent., who are serving continuously as chief petty officer.

Pharmacists are appointed from among those chief petty officers of the Hospital Corps who are serving under permanent appointment who have an average service mark of not less than 85 per cent. and are under thirty-five years of age.

Pay clerks are appointed from among chief petty officers of the navy who have served at least three years as enlisted men, two years of which must have been on board a cruising vessel. Warrant officers are commissioned chiefs, with rank of ensign, after six years' service.

The advancement which is open to ambitious young men who enlist in the navy is not limited to the grade of warrant officer. There are several avenues open for promotion to commission; for example:

A boatswain, gunner, or machinist, or a chief boatswain, chief gunner, or chief machinist, who has been in his grade four years and is under thirty-five, may enter the examination for appointment as ensign; this examination is held every year, appointments being limited to twelve annually. A man who wins a commission in this manner is entitled to the same pay, privileges, honors, and opportunities for further advancement as are open to officers who are graduates of the Naval Academy.

Pay clerks and chief pay clerks under thirty-five may compete in the examination for appointment as assistant paymasters in the navy. This examination is usually held each year and is competitive.

The young men who are appointed to the Naval Academy in accordance with the examinations previously described will, upon graduation, be given commissions in the navy.

Any disabled person who has served as an enlisted man in the navy for ten years, and has not been discharged for misconduct, may apply for aid from the surplus income of the naval pension fund, which may be granted upon the recommendation of a board of not less than three naval officers in "suitable amount," to be approved by the Secretary of the Navy. This service pension is in addition to a disability pension under the general law, which may be allowed him by the Pension Office.

After twenty years of service any enlisted man disabled from sea service by reason of age or infirmity, and who has not been discharged for misconduct, shall, if he so elect, be entitled to a pension equal to half pay, or be admitted into the Naval Home, Philadelphia, Pa.

Men who have had sixteen years' service and are entitled to honorable discharge may be transferred to the Naval Reserve at one-third of their pay and permanent increases; and men who have had twenty years' service may, in like manner, be transferred to the Naval Reserve at one-half their pay and permanent increases.

Any enlisted man who has served thirty years may be placed upon the retired list at three-fourths of his pay, with additional allowances for rations, quarters, fuel, and light, amounting to $15.75 a month. All service in the Navy, Army, or Marine Corps is credited for retirement.

Requirements for Enlistment

The term of enlistment of all enlisted men of the navy is four years, except minors over seventeen and under eighteen years of age, who shall be enlisted for the period

of minority. Minors under seventeen cannot enlist in the navy except by special permission of the Bureau of Navigation. No enlistments for special service are allowed.

No minor under the age of eighteen years will be enlisted without the written consent of the parent who is his legal guardian; or, if both parents are dead, of a legally appointed guardian.

The minimum weight for acceptance of a man twenty-one years old is 128 pounds. A variation of ten pounds, not to fall below 128 pounds in weight, or two inches in chest measurement below the standard given in the table for adults, is admissible when the applicant for enlistment is active, has firm muscles, and is evidently vigorous and healthy, except for enlistment in the rate of coal passer, for which rate full standard measurements will be required.

Chest expansion of less than two inches in a minor or of less than two and a half inches in an adult is a sufficient cause for rejection of an applicant.

Applicants between the ages of seventeen and eighteen must obtain the written consent of their parents or guardians, on forms provided for that purpose, on application to any recruiting station or navy yard, before proceeding to the recruiting station. Those between the ages of eighteen and twenty-one should similarly obtain an age certificate and have it filled out and signed before leaving home.

Evidence of Age and Citizenship

The law requires that every applicant for enlistment as apprentice-seaman must, if a minor, present a certificate of birth, or verified written statement by his parents, or either of them, or, in case of their death, a verified written statement by his legal guardian, showing the applicant to be of age required by the Naval Regulations, before he can be enlisted. He must also produce satisfactory evidence of his United States citizenship, native or naturalized. Blanks are provided for this purpose. No

minor under the age of seventeen years, no insane or intoxicated person, and no deserter from the naval or military service of the United States, shall be enlisted in the naval service.

No man convicted of any serious offense will be enlisted without special permission of the Bureau of Navigation.

Fraudulent enlistment, and the receipt of any pay or allowance thereunder, is an offense against naval discipline, and is punishable by general court-martial. (Act approved March 3, 1893.)

First enlistment in the navy shall be made only in the ratings of the following table and between the ages therein specified for the different ratings:

Rating	Years of service	Rating	Years of service
Seamen	21 to 30	Shipfitters, second class	21 to 30
Ordinary seamen	18 to 30	Coppersmiths	21 to 30
Apprentice-seamen	17 to 25	Firemen, first class	21 to 30
Landsmen (not for seamen branch)	18 to 25	Firemen, second class	21 to 30
Shipwrights	21 to 30	Coal passers	21 to 30
Blacksmiths	21 to 30	Hospital apprentices	18 to 25
Plumbers and fitters	21 to 30	Bakers, second class	21 to 30
Sailmaker's mates	21 to 30	Mess attendants, third class	18 to 30
Machinist's mates, first class	21 to 30	Ship's cooks, fourth class	18 to 30
Machinist's mates, second class	21 to 30	Musicians, first class	21 to 30
Boilermakers	21 to 30	Musicians, second class	21 to 30
		Painters, third class	21 to 30

All applicants for enlistment in the navy must personally appear at a navy recruiting station or navy yard, and there be examined as to their qualifications for enlistment. Applicants residing at a distance from such recruiting station or navy yard should, in all cases, carefully consider whether they can meet the requirements for

enlistment as given in this book. If necessary, they should consult a local physician and ascertain the probabilities of their being able to conform to these requirements. If reasonably sure of passing the physical examination, they should then write to the recruiting station or navy yard at which they intend to apply for enlistment, requesting to be informed as to whether or not enlistments are being made in the ratings for which they are eligible, or, if enlistments are not then being made in those ratings, to be notified as soon as they are being made.

This course is suggested as no allowance is made for travelling expenses of applicants, and they should be as certain as possible of their ability to pass the examination before incurring any expense. Transportation is furnished only to accepted applicants from the recruiting station to the point of assignment. Frequently enlistments are suspended in some of the ratings mentioned in the foregoing table, and an applicant should not take it for granted that enlistments are being made in a given trade.

The tables are given to show what is regarded as a fair standard of physical proportions, and not as an absolute guide to be followed in deciding upon the acceptance of recruits.

For a minor enlisting as apprentice-seaman:

	Minimum height barefooted	Minimum weight without clothes
	Inches	*Pounds*
At 17 years of age.	62	110
At 18 years of age.	64	115
At 19 years of age.	64	120
At 20 years of age.	64	125

No underweight or underheight is allowed in minors.

Marked disproportion of weight over height is not a cause for rejection unless the applicant is positively obese.

Any one of the following conditions will be sufficient to cause the rejection of the applicant:

1. Feeble constitution, general poor physique, or impaired general health.

2. Any disease or deformity, either congenital or acquired, that would impair efficiency, such as: Weak or deranged intellect, cutaneous disease not of a mild type, parasites of the skin or its appendages, deformity of the skull, abnormal curvature of the spine, torticollis, inequality of upper or lower extremities, inefficiency of joints or limbs, deformity of joints or bones, either congenital or the result of disease or injury; flat feet, evidence of epilepsy or other convulsions, defective vision (minimum 15/20 S. in either eye), disease of the eye, color-blindness, impaired hearing or disease of the ear, chronic nasal catarrh, ozæna, polypi, great enlargement of tonsils, impediment of speech, disease of heart or lungs or predisposition to such disease, enlarged abdominal organs or evidence of cirrhosis, tumors, hernia, undescended testicle, large varicocele, sarcocele, hydrocele, stricture, fistula, hemorrhoids, large varicose veins, disease of the genito-urinary organs, chronic ulcers, ingrowing nails, bad corns, large bunions, deformity of toes, loss of many teeth or teeth generally unsound (teeth properly filled not to be considered unsound). Every recruit must have at least twenty sound teeth, and of these not less than four opposed incisors and four opposed molars.

3. Any acute disease.

Each recruit shall be required to take the oath of allegiance. He will also be required to declare on oath, in the presence of the recruiting officer, that he makes a true statement as to the date and place of his birth, and his previous service, if any, in the Navy, Marine Corps, Army, or Coast Guard Service; and also that he is not subject to fits, has no disease concealed or likely to be inherited, and has no stricture or internal piles.

Applicants for enlistment must be American citizens,

native or fully naturalized, and must be able to read and write English. "First papers" are not sufficient.

The modern tendency is to hold in the navy only those who are satisfied and efficient, and to allow the discontented ones to obtain their discharge. Furthermore, many very satisfactory men find that, due to changing conditions, they can benefit themselves and their families on the "outside." They are still valuable to the country even after they leave the navy and willingly agree to serve in the Naval Reserve.

APPENDIX

DRILL INSTRUCTIONS FOR 5-INCH 51-CALIBRE GUN USING SEPARATE AMMUNITION.

NOTE.—Powder in bags instead of in brass cartridge cases.

Gun Captain.

The gun captain acts as plugman.

Operates the plug operating lever and primes the gun.

At every drill he is actually to prime the gun with dummy primers and must be given constant extra drill in this duty.

He is responsible for the conduct, efficiency, and spirit of the crew, who must be made to realize that he is the representative of the battery officer and in absolute charge at the gun. He will be often detailed to conduct drills and must know all about his gun, the duties of each member of the crew, first aid, and the action needed to meet all casualties. He is responsible for the safety of the gun and crew, and must report immediately any casualties or unusual conditions to the group control officer and the battery officer. He is responsible for all gear at the guns, and for the prompt and accurate execution of all orders received from group control officer.

Pointer.

Operates elevating wheel to keep his horizontal wire on the point of aim and coaches trainer to keep vertical wire on. Fires the gun, when crosswires are steady on the point of aim and only when buzzer or other designated firing signal is sounding.

Trainer.

Operates training wheel to keep his vertical wire on so as to require very little coaching by the pointer after they have once checked up. In case of casualty to the pointer's sight, trainer continues to keep his own vertical wire on, and coaches pointer to bring the horizontal wire on, when crosswire is on the point of aim, trainer sings out "Mark!" at which time the pointer may fire.

Sightsetter.

Sets sights and transmits all communications between gun and group control officer.

Trayman.

Operates tray to protect screw box. Operates gas ejector.

Combination Sponge and Rammer Man.

Wipes off mushroom after each shot.

Operates combination sponge and rammer when casualty requires.

First Shellman.

Loads shell in gun.

Second Shellman.

Keeps first shellman supplied with shell.

First Powderman.

Loads powder in gun.

Second Powderman.

Keeps first powderman supplied with powder.

PREPARING THE BATTERY FOR EXERCISE, AND SECURING.

In general the detailing of members of the crew for the performance of individual duties under this head is *left to* the division officer whose duty, performed as far *as possible* through the gun captains, is to see that his

battery is expeditiously prepared in all respects for the drill or exercise that is to be carried out.

In General.

Clear away the gun. (Gun crews will remove and replace gun shutters at all times ordered.)

Take out tompion.

Test: training gear, elevating gear, breech mechanism, firing mechanism, percussion firing, gas ejector, sights, lights, fire control system.

Communicate with magazine crews, test hoist signals and hoist. The gun cannot be regarded as fully ready until ammunition supply is ready.

Take off friction disc cover.

Provide: Combination sponge and rammer, hand sponge, loader's gloves, loading tray, gun and safety rules, tub of water, bucket of drinking water, first aid kit, primer belt, primers, priming tools, large wrench, hand electric light, lens paper.

For General Quarters leave hoist cover down after testing hoist.

After firing or drill swab out the gun as necessary.

Special Duties.

Gun Captain.

Operates plug with right hand, standing close to gun, and primes with left hand. On opening plug, checks swing of plug with left hand to avoid jarring gun.

Watches salvo latch to know when gun has fired.

Notes return of gun to battery.

Watches firing lock, when he closes plug, to see that primer is properly seated, and firing pin in place, making proper contact.

Each load, sees that shellman inspects to see bore clear before loading shell, and that powderman loads red end aft, and only after "bore clear" has been announced.

When gun is loaded, sings out " Ready! "

Carries primers in belt and has primer extractor hanging to belt.

Pointer.

Removes sight caps, provides lens paper, cleans sights and check sights as necessary. Examines firing circuit and sight lights, using both motor generator and battery. Tests elevating gear and reports " ready " to gun captain.

Checks crosswires with trainer.

Keeps crosswire at all times on point of aim.

Fires gun; but only when the following conditions are met: After " commence firing," gun " ready," sights set, crosswires steady on point of aim, and firing signal sounding.

Trainer.

Turns on the air, trains gun on designated arc by arc of train pointer; takes off sight cap; cleans sight as necessary; and examines crosswire illumination. Reports " Ready " to gun captain.

As soon as target is designated the pointer and trainer check each other on it.

Sightsetter.

Turns on sight lights; checks up zero of scale and sword arm.

Operates range and deflection scales as directed by group control officer.

Sets sights, range first, repeating ranges and deflections for gun captain's check; and reports " Set! " to pointer when sights have been set. Examines sights after each shot, resetting as necessary.

Repeats to the gun captain all orders coming from group control.

If ranges or orders are not understood, sings out *" Repeat! "* over voice tube (or telephone).

During firing, should regular firing interval elapse without any firing signal reaching him, sings out "No buzzer on gun ——!" and makes sure he has been heard, by requiring an acknowledgment.

Minimizes talking through voice tube in order to give communications from group control officer right of way.

Trayman.

Stands to left and rear of breech.

Holds tray, right hand on upper handle.

Inserts tray as soon as plug is opened, and removes it quickly after gun is loaded. Always keeps tray parallel to axis of bore.

Leaves air on while plug is open.

Combination Sponge and Rammer Man.

Under normal conditions of firing, wipes off mushroom with wet hand sponge, after each shot.

Stands to left of and close to plugman, left foot forward, facing breech.

As plug is opened, wipes off mushroom carefully, using wet sponge held in left hand, and wipes out screw box if necessary.

In any case of foul bore, dips combination sponge and rammer in gun tub, rams shell home, withdrawing sponge with spiral motion, which sponges chamber and mushroom.

First Shellman.

In rear of breech, facing to right, as close to gun as safety will permit.

Holds shell in the hands, point forward, directly in rear of and parallel to bore.

The shell is held with left hand midway between point and rotating band; and with right hand, palm against base, fingers downward.

Endeavors to seat shell firmly, avoiding striking tray, and makes way quickly for powderman.

In event of foul bore he sings out " Foul bore! " and, after loading shell, blocks powderman clear of gun.

Second Shellman.

Arranges shells on deck in rear of gun.

Stands to rear and right of first shellman, directly in line of bore, right foot forward; and stands in position to enable him to look through bore as plug is opened. Picks up shell with both hands around the middle, so that first shellman may receive it in position to load.

As plug is opened, he examines bore, and if it is clear he sings out "Bore clear!" The gun must not be loaded until this report is made.

If bore is not clear, he sings out " Foul bore! "

First Powderman.

Stands directly in rear of breech, facing first shellman, and just to right of axis of bore produced. Braces himself firmly with feet well apart, right foot directly under breech of gun. Holds powder bag—red end in left hand, right hand near the middle—parallel to axis of bore, becketed end directly in rear of plug in position to be just clear of lock when gun recoils. As shell is loaded, powderman shifts weight of body to right leg, carrying powder bag forward, inserts bag closely following shell, and pushes with left fist, ramming the shell fully home. He must be careful to seat the shell.

Second Powderman.

Arranges powder tanks, standing them upright, on deck to rear and right of gun, clear of all members of crew.

Stands to left of first powderman.

As powder is loaded in gun, he takes another charge from the tank, and gives it—red end to rear—to the first powderman.

Cease Firing! (Command.)

Gun captain withdraws primer and examines it to see that it has not fired.

Unload! (Command.)

To unload, remove primer if it has not already been withdrawn, and examine it to see that it has not fired. If not, open breech, remove powder charge and shell. Return powder charge to tank and carefully mark tank for identification. If firing is not resumed, this charge, upon Gunnery Officer's orders, will be subsequently dumped into distilled water. [I-2858(2).] If the primer has fired, the gun will be treated as a hang-fire.

CASUALTIES.

Jammed Primer. (Mark XIII lock.)

There are three kinds of primer jams.

(1) FEED JAMS: Where the primer is not fed through the primer guide.

Procedure: Look at the lock, see first if the hammer has fallen all the way; if it has not, the wedge will be about 9-10 of an inch from closed. Pull the hammer back (not too far if using two primers) and release it. This should force primer through guides.

(2) WEDGE JAM: Where primer has fed through the primer guide but jams in primer seat and prevents wedge from closing. This may occur following a Feed Jam.

Procedure: In this case, primer is clear of primer guide—hence, eject primer with considerable force, and reprime.

(3) REPEATED FEED JAM: Where primer refuses to feed through the guide, even after the hammer has been dropped on the primer several times.

Procedure: This case is unusual, and the only remedy is to take down the lock and clear the jammed primer.

All members of the loading crew should be instructed to recognize instantly these three kinds of primer jams.

The trayman and first shellman are in particularly advantageous positions to recognize the nature of the jam, and should be given special training to the end that they may call out readily the type of jam, for the information of the plugman.

Mis-Fires.

Most mis-fires are due to the failure of the pointer to make proper contact with the firing key. The pointer must always press down hard on the firing key, and hold it down for an appreciable interval.

If the gun fails to fire the pointer sings out "Mis-fire!" The gun captain immediately cocks piece, holding back cocking arm with left hand, and sings out "Ready percussion!" When the pointer is again ready to fire he sings out "Fire!" at which the gun captain releases cocking arm and jerks his arm out of the way.

(a) If gun fires, pointer must shift transfer switch before firing next shot.

(b) If gun fails to fire, gun captain sings out "Mis-fire; shift primer." He extracts and examines primer; if it has fired, the procedure for "hang fire" shall be followed. If the primer has not fired, a new primer is inserted; and, when it is seated, the gun captain sings out "Ready." While gun captain is shifting primer, pointer shifts transfer switch and endeavors to fire next shot electrically. If gun again fails to fire after transfer switch has been shifted, continue the firing by percussion until opportunity offers for repairing firing circuit.

Hang-Fire.

If the gun fails to fire, and the extracted primer shows that the primer has fired, the condition of "hang-fire" exists.

Observe requirements of Naval Instructions after continued efforts have failed to fire gun.

Foul Bore.

In any case of foul bore, anyone noting same shall sing out " Foul bore! "

First powderman instantly jumps away from breech of gun with exposed powder bag.

Second powderman, assisted by other members of gun crew, gets powder tanks clear.

First shellman loads shell in gun, and blocks first powderman.

Combination sponge and rammer man dips sponge in water, rams shell and swabs out chamber.

Crosswires Out of Adjustment.

During the firing, should the crosswires of either sight be far out, report it to gun captain at once. This will be recognized, probably, at once; but if not, it may be detected by the excessive coaching of the pointer and difficulty he has in getting and keeping the trainer on. The gun captain at once goes to the check sight and checks them up. If one sight is practically on with the check, and the other off, then the man who is " on " does the firing and coaches the other as best he can. If he be the trainer, he fires by singing out "Fire" when his crosswires are on the target, and the pointer presses the firing key. The check telescope is always bore-sighted with the other.

Blurred Sights.

Lens paper is kept close at hand by both pointer and trainer for use in case sights become blurred. Gun captains should caution them to wipe off their sights whenever they appear to be having any trouble of any kind with them, or in seeing the target clearly.

Broken Powder Bag.

Stop firing until all loose grains of powder have been picked up from around gun and out of screw box, and dumped into tub of water. Wash out screw box with water and sponge to insure the removal of all black powder grains.

Broken Air Line.

Trayman keeps end of air hose from whipping around.

Second powderman immediately turns off air valve under gun.

Combination sponge and rammer man must then sponge out powder chamber after each shot.

Failure to Return to Battery.

In case gun fails to return to battery, cease firing; do not load the gun; depress gun as far as possible. Pointer elevates and depresses quickly with jerky motion of elevating wheel; trainer trains right and left in same manner; gun crew endeavors to raise gun and jar it back into battery. Marks should be fixed or painted on gun to indicate to gun captain whether or not gun has fully returned to battery.

Other Casualties.

Other casualties, such as jammed plug, choked vent, burred screw box, will be remedied as quickly as possible, sending for a gunner's mate for assistance or spare parts.

Removal of Personnel Casualties.

It is the duty of the gun crew to continue the service of the gun and to overcome every obstacle which interferes therewith. The gun crew will, therefore, not cease their operation of loading, but two men nearest to the wounded man should, without orders, place him in any convenient position clear of the working of the gun and return to their duties.

Changing Stations.

As soon as the personnel is fairly proficient at their regular stations they should be exercised at other stations in their own units, in order that the personnel may be proficient not only at their own stations, but

also have a thorough idea of their relation to the rest of the personnel and have a groundwork of training as reliefs.

Battery Officer's "Check Off List"

For Preparing 5-inch 51-Calibre Battery for Firing.

Remove ex-calibre guns and bands.
Paint safety circle on deck.
Examine trunnion knife edges.
Adjust and measure trunnion clearance.
Clean and oil slide.
Examine yoke keep-screws.
Paint mark on gun to indicate when gun fails to return to battery.
Overhaul plug, examine gas check pad and rings.
Mount and test salvo latch.
Boregauge.
Clean gas ejector valve.
Test air leads.
Inspect tray.
Examine powder.
Examine shells and tracers. (Paint shells for target practice.)
Overhaul and adjust elevating gear.
Overhaul and adjust training gear.
Clean and adjust friction discs.
Secure and test voice tube.
Remove any gear stowed overhead.
Glue on reduced charge range scales (target practice).
Adjust crosswire illumination.
Examine eye buffers.
Remove parallax from sights.
Clean sights.
Secure sights and crosswires firmly.
Bore sight at expected firing range (adjusting check telescope and sword scale).
Clean lenses with alcohol.
Soap lenses.
Overhaul firing lock.
Clean and dry contacts and firing keys.
Recharge battery.
Test firing circuit, voltage of M. G.
Test firing circuit, voltage of battery.
Inspect and test battle lanterns.
Inspect and test telephones.
Inspect and test buzzers.
Clean and test primers.
Fill recoil cylinders.
Remove tompions.
See all nuts in place and set up.

Provide the Following:

Lens paper.
Gun tub and water.
Marine sponge.
Bucket drinking water.
Loading gloves.
Bore-brush or swab.
First aid packet.
Boric acid.
Tools.
Spare parts.
Whistle for battery officer.
Hand lamps.
Cotton for crew.

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